As further revealed by Examiner Langel, and confirmed by two other Examiners, "allowance is not an option" in any pending BlackLight application according to official PTO policy. Under that arbitrary policy, the anonymous group of individuals, i.e. "Secret Committee," responsible for directing the named Examiner's actions in this case has knowingly violated well-established patent laws and procedures in presuming the utility of Applicant's novel hydrogen technology to be *per se* incredible as an excuse for its failure to properly consider and evaluate the scientific evidence of record amassed by Applicant at great expense. [See, e.g., MPEP § 2107, pp. 2100-31 ("A conclusion that an asserted utility is incredible can be reached only after the Office has evaluated both the assertion of the applicant regarding utility and any evidentiary basis of that assertion. The [Examiner] should be particularly careful not to start with a presumption that an asserted utility is, *per se*, "incredible" and then proceed to base a rejection under 35 U.S.C. 101 on that presumption.")]

To the limited extent that the Committee has begun to address Applicant's evidence in any of his pending cases, it has done so by relying primarily upon the biased views of its newest principal member, Dr. Bernard Eng-Kie Souw, who was assigned to replaced Examiner Langel and examine all of BlackLight's pending applications. As discussed below, those biased views lack credibility not just on the merits, but also due to a genuine conflict of interest involving Dr. Souw's contemporaneous ownership of, and work as the lead scientist for, a company that competes with BlackLight in the same technical areas. Consequently, the Committee's rejections in all of BlackLight's cases, including this one, which have adopted Dr. Souw's biased views, are fatally defective and should be immediately withdrawn so that these cases can be allowed to issue.

The rejection of the claims 17-300 under 35 U.S.C. § 101 as being inoperative and lacking utility is respectfully traversed. Applicant respectfully submits that the Committee has not met its burden of raising a *prima facie* case of inoperability for the many reasons of record and, therefore, the rejection should be withdrawn for those reasons alone. Furthermore, Applicant has disclosed substantial experimental evidence in the present disclosure, prior submissions, and submissions herewith that fully rebut any *prima facie* case of inoperability the Committee might have raised. Applicant

responds more fully to the Committee's comments, discusses the experimental evidence of record, and summarizes the improper prosecution procedures used by the Committee in the following paragraphs. For these additional reasons, the Section 101 rejection should be withdrawn.

The related rejection of claims 17-300 under 35 U.S.C. § 112, first paragraph, as lacking enablement, is also respectfully traversed. Applicant respectfully submits that the Committee has not met its burden of raising a *prima facie* case of lack of enablement for the many reasons of record and, therefore, the rejection should be withdrawn for those reasons alone. Furthermore, Applicant has disclosed substantial experimental evidence in the present disclosure, prior submissions, and submissions herewith that fully rebut any *prima facie* case of lack of enablement the Committee might have raised. Applicant responds more fully to the Committee's comments, discusses the experimental evidence of record, and summarizes the improper prosecution procedures used by the Committee in the following paragraphs. For these additional reasons, the Section 112, first paragraph, rejection should be withdrawn.

Applicant has filed Rule 132 Declarations certifying his submitted experimental evidence, which further rebuts the Committee's unjustified utility and enablement rejections of the claimed invention. This evidence, which the Committee required Applicant to make public by submitting it to scientific journals for publication, conclusively confirms the formation of lower-energy hydrogen through practice of Applicant's novel hydrogen chemistry. To this day, the Committee has failed to properly consider the numerous Rule 132 Declarations previously filed by Applicant in violation of its own rules, as outlined in MPEP § 716:

> Evidence traversing rejections <u>must</u> be considered by the examiner whenever present. <u>All</u> entered affidavits, declarations, and other evidence traversing rejections are acknowledged and commented upon by the examiner in the next succeeding action. ... Where the evidence is insufficient to overcome the rejection, the examiner <u>must</u> specifically explain why the evidence is insufficient. General statements such "the declaration lacks technical validity" or "the evidence is not commensurate with the scope of the claims" without an explanation supporting such findings are insufficient. [Emphasis added.]

The Committee does not even mention, let alone consider, most of the certified experimental evidence identified in Applicant's Rule 132 Declarations that were submitted to overcome the rejections of record.

Lower-Energy Hydrogen Experimental Data

With this latest submission, Applicant now has over 100 articles and books of record in this case, as reflected in the "List of References" set forth below. These articles detail studies that experimentally confirm a novel reaction of atomic hydrogen, which produces hydrogen in fractional quantum states that are at lower energies than the traditional "ground" ($n = 1$) state, a chemically generated or assisted plasma (rt-plasma), and novel hydride compounds, including:

extreme ultraviolet (EUV) spectroscopy,[1]
characteristic emission from catalysis and the hydride ion products,[2]
lower-energy hydrogen emission,[3]
plasma formation,[4]
Balmer α line broadening,[5]
population inversion of hydrogen lines,[6]
elevated electron temperature,[7]
anomalous plasma afterglow duration,[8]
power generation,[9]
excessive light emission,[10] and
analysis of chemical compounds.[11]

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[1] Ref. Nos. 11-16, 20, 24, 27-29, 31-36, 39, 42-43, 46-47, 50-52, 54-55, 57, 59, 63, 65-68, 70-76, 78-79, 81, 83, 85, 86, 89, 91-93, 95-96, 98, 101, 104, 108-109, 110-112. The complete list of reference Nos. is shown below.
[2] Ref. Nos. 24, 27, 32, 39, 42, 46, 51-52, 55, 57, 68, 72-73, 81, 89, 91, 108
[3] Ref. Nos. 14, 28-29, 33-36, 50, 63, 67, 70-71, 73, 75-76, 78-79, 86-87, 90, 92, 93, 98, 101, 104, 110-112
[4] Ref. Nos. 11-13, 15-16, 20, 24, 27, 32, 39, 42, 46-47, 51-52, 54-55, 57, 72, 81, 89, 91-93, 108-109
[5] Ref. Nos. 16, 20, 30, 33-37, 39, 42-43, 49, 51-52, 54-55, 57, 63-65, 68-69, 71-74, 81-85, 88-89, 91, 92, 93, 95-97, 105, 108-109, 114
[6] Ref. Nos. 39, 46, 51, 54, 55, 57, 59, 65-66, 68, 74, 83, 85, 89, 91
[7] Ref. Nos. 34-37, 43, 49, 63, 67, 73
[8] Ref. Nos. 12-13, 47, 81
[9] Ref. Nos. 30-31, 33, 35-36, 39, 43, 50, 63, 71-73, 76-77, 81, 84, 89, 92, 93, 98, 101, 104, 108, 110-112
[10] Ref. Nos. 11, 16, 20, 23, 31, 37, 43, 52, 72, 109
[11] Ref. Nos. 6-10, 19, 25, 38, 41, 44-45, 60-62, 64, 69, 75, 81-82, 87-88, 90, 92, 93, 94, 98, 100, 101, 104, 108, 110-112

In addition, Applicant has shown that direct plasma to electric power conversion is possible using this novel hydrogen chemistry.[12]

A summay of Applicant's experimental data confirming the existence of lower-energy hydrogen is set forth below:

1.) the observation of intense extreme ultraviolet (EUV) emission at low temperatures (e.g. $\approx 10^3\ K$) from atomic hydrogen and only those atomized elements or gaseous ions which provide a net enthalpy of reaction of approximately $m \cdot 27.2\ eV$ via the ionization of t electrons to a continuum energy level where t and m are each an integer (e.g. K and Cs atoms and Rb^+ and Sr^+ ions ionize at integer multiples of the potential energy of atomic hydrogen and caused emission; whereas, the chemically similar atoms, Na, Mg, and Ba, do not ionize at integer multiples of the potential energy of atomic hydrogen and caused no emission),[13]

2.) the observation of novel EUV emission lines from microwave and glow discharges of helium with 2% hydrogen with energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,11,12$ or these lines inelastically scattered by helium atoms in the excitation of $He\,(1s^2)$ to $He\,(1s^1 2p^1)$ that were identified as hydrogen transitions to electronic energy levels below the "ground" state corresponding to fractional quantum numbers,[14]

3.) the observation of novel EUV emission lines from microwave and glow discharges of helium with 2% hydrogen at $44.2\ nm$ and $40.5\ nm$ with energies of $q \cdot 13.6 + \left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) X 13.6\ eV$ where $q = 2$ and $n_f = 2,4$ $n_i = \infty$ that corresponded to multipole coupling to give two-photon emission from a continuum excited state atom and an atom undergoing fractional Rydberg state transition,[15]

4.) the identification of transitions of atomic hydrogen to lower energy levels corresponding to lower-energy hydrogen atoms in the extreme ultraviolet emission spectrum from interstellar medium and the sun,[16]

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[12] Ref. Nos. 18, 26, 40, 48, 56, 68
[13] Ref. Nos. 11-13, 15-16, 20, 24, 27, 32, 39, 42, 46-47, 51-52, 54-55, 57, 72, 81, 89, 91-93, 108-109
[14] Ref. Nos. 28, 33-36, 50, 63, 67, 71, 73, 75-76, 78, 86-87, 90
[15] Ref. Nos. 36, 71, 73
[16] Ref. Nos. 1, 5, 17, 28-29

5.) the observation that the novel EUV series of lines with energies of $q \cdot 13.6\ eV$ was observed with an Evenson microwave cell, only the peak corresponding to $q = 2$ was observed with an RF cell, and none of the peaks were observed with a glow discharge cell,[17]

6.) the observation that in a comparison of Evenson, McCarroll, cylindrical, and Beenakker microwave cavity plasmas, the novel EUV series of lines with energies of $q \cdot 13.6\ eV$ was only observed for Evenson-cavity helium-hydrogen plasmas,[18]

7.) the EUV spectroscopic observation of lines for a hydrogen-K catalyst plasma by the Institut für Niedertemperatur-Plasmaphysik e.V. that could be assigned to transitions of atomic hydrogen to lower energy levels corresponding to fractional principal quantum numbers and the emission from the excitation of the corresponding hydride ions,[19]

8.) the recent analysis of mobility and spectroscopy data of individual electrons in liquid helium which shows direct experimental confirmation that electrons may have fractional principal quantum energy levels,[20]

9.) the observation of novel EUV emission lines from microwave discharges of argon or helium with 10% hydrogen that matched those predicted for the reaction $H(1/4) + H^+ \rightarrow H_2(1/4)^+$ having an energy spacing of 2^2 times the transition-state vibrational energy of H_2^+ with the series ending on the bond energy of $H_2(1/4)^+$,[21]

10.) the result that the novel vibrational series for the reaction $H(1/4) + H^+ \rightarrow H_2(1/4)^+$ was only observed for catalyst plasmas of helium, neon, and argon mixed with hydrogen, but not with noncatalyst xenon or krypton mixed plasmas,[22]

11.) the observation that based on the intensities of the peaks, the catalyst and the plasma source dependence of the reaction rate to form $H_2(1/4)^+$ is $Ar^+ > He^+ > Ne^+$ and microwave > glow discharge >> RF, respectively,[23]

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[17] Ref. Nos. 71, 73
[18] Ref. No. 76
[19] Ref. No. 14
[20] Ref. Nos. 17, 53
[21] Ref. Nos. 29, 70, 73, 79, 92, 93, 98, 101, 104
[22] Ref. Nos. 29, 70, 73, 79, 92, 93, 101
[23] Ref. No. 70

12.) the observation that the microwave plasma source dependence of the reaction rate to form $H_2(1/4)^+$ is Evenson microwave > McCarroll, cylindrical, Beenakker,[24]

13.) the observation of a series of vibration-rotational bands in the 60-67 nm region, a high-energy region for which vibration-rotational spectra are ordinarily unknown, emitted from low-pressure helium-hydrogen (99/1%) microwave plasmas that matched the predicted energy spacing of the vibrational energy of H_2 about the bond energy of $H_2(1/2)$ corresponding to the reaction $2H(1/2) \rightarrow H_2(1/2)$,[25]

14.) the observation of EUV plasma emission spectra in the region $60\ nm$ to $100\ nm$ that matched the predicted emission lines $E_{D\,H_2}$ due to the reaction $2H(1/2) \rightarrow H_2(1/2)$ with vibronic coupling at energies of $E_{D+vib} = 17.913 \pm \left(\frac{\upsilon^*}{3}\right) 0.515902\ eV$ to longer wavelengths for $\upsilon^* = 2$ to $\upsilon^* = 32$ and to shorter wavelengths for $\upsilon^* = 1$ to $\upsilon^* = 16$ to within the spectrometer resolution of about $\pm 0.05\%$,[26]

15.) the observation that in addition to members of the series of novel emission lines with energies of $q \cdot 13.6\ eV$ or $E_{D+vib} = 17.913 \pm \left(\frac{\upsilon^*}{3}\right) 0.515902\ eV$ an additional intense peak was observed from a scaled-up Evenson cell at $41.6\ nm$ with an energy of $29.81\ eV$ that matched $q \cdot 13.6\ eV$ with $q = 4$ less $24.58741\ eV$ corresponding to inelastic scattering of these photons by helium atoms due to ionization of He to He^+,[27]

16.) the observation that in a comparison of Evenson, McCarroll, cylindrical, and Beenakker microwave cavity plasmas, the novel series of spectral lines due to the reaction $2H(1/2) \rightarrow H_2(1/2)$ with vibronic coupling at energies of $E_{D+vib} = 17.913 \pm \left(\frac{\upsilon^*}{3}\right) 0.515902\ eV$ was only observed for Evenson-cavity helium-hydrogen and neon-hydrogen plasmas,[28]

17.) the observation by gas chromatography that hydrogen was consumed by the helium-hydrogen plasmas which showed the novel EUV series of lines with energies of

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[24] Ref. No. 79
[25] Ref. No. 99
[26] Ref. Nos. 50, 75-76, 78, 86-87, 90
[27] Ref. No. 86
[28] Ref. No. 76

$q \cdot 13.6\ eV$, the novel series of spectral lines due to the reaction $2H(1/2) \rightarrow H_2(1/2)$ with vibronic coupling at energies of $E_{D+vib} = 17.913 \pm \left(\frac{\upsilon^*}{3}\right) 0.515902\ eV$, extraordinary H Balmer line broadening corresponding to $180 - 210\ eV$, and excess power of 21.9 W in 3 cm^3,[29]

18.) the observation of the dominant He^+ emission and an intensification of the plasma emission observed when He^+ was present with atomic hydrogen demonstrated the role of He^+ as a catalyst, [30]

19.) the observation of continuum state emission of Cs^{2+} and Ar^{2+} at $53.3\ nm$ and $45.6\ nm$, respectively, with the absence of the other corresponding Rydberg series of lines from these species which confirmed the resonant nonradiative energy transfer of $27.2\ eV$ from atomic hydrogen to the either Cs or Ar^+ catalyst,[31]

20.) the spectroscopic observation of the predicted hydride ion $H^-(1/2)$ of hydrogen catalysis by either Cs or Ar^+ catalyst at $407\ nm$ corresponding to its predicted binding energy of $3.05\ eV$,[32]

21.) the observation of characteristic emission from K^{3+} which confirmed the resonant nonradiative energy transfer of $3 \cdot 27.2\ eV$ from atomic hydrogen to atomic K,[33]

22.) the spectroscopic observation of the predicted $H^-(1/4)$ ion of hydrogen catalysis by K catalyst at $110\ nm$ corresponding to its predicted binding energy of $11.2\ eV$,[34]

23.) the observation of characteristic emission from Rb^{2+} which confirmed the resonant nonradiative energy transfer of $27.2\ eV$ from atomic hydrogen to Rb^+,[35]

24.) the spectroscopic observation of the predicted $H^-(1/2)$ ion of hydrogen catalysis by Rb^+ catalyst at $407\ nm$ corresponding to its predicted binding energy of $3.05\ eV$,[36]

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[29] Ref. No. 76
[30] Ref. Nos. 36, 73
[31] Ref. Nos. 24, 39, 51, 54-55, 57, 91
[32] Ref. No. 24
[33] Ref. Nos. 27, 39, 42, 46, 51, 54-55, 57, 81, 89, 91
[34] Ref. Nos. 81, 42, 27
[35] Ref. Nos. 32, 39, 42, 46, 51, 54-55, 57, 81, 89, 91
[36] Ref. No. 32

25.) the observation of $H^-(1/2)$, the hydride ion catalyst product of K^+/K^+ or Rb^+, at its predicted binding energy of $3.0468\ eV$ by high resolution visible spectroscopy as a continuum threshold at 4068.2 Å and a series of structured peaks separated from the binding energy by an integer multiple of the fine structure of $H(1/2)$ starting at 4071 Å that matched predicted free-free transitions,[37]

26.) the observation that the high resolution visible K^+/K^+ or Rb^+-H_2 plasma emission spectra in the region of 3995 to 4060 Å matched the predicted bound-free hyperfine structure lines E_{HF} of $H^-(1/2)$ calculated from the electron g factor as $E_{HF} = j^2 3.00213\ X 10^{-5} + 3.0563\ eV$ (j is an integer) for $j = 1$ to $j = 39$ (3.0563 eV to 3.1012 eV—the hydride binding energy peak plus one and five times the spin-pairing energy, respectively) to within a 1 part per 10^4,[38]

27.) Rb^+ or $2K^+$ catalysts formed a plasma having strong VUV emission with a stationary inverted Lyman population with an overpopulation sufficient for lasing, and emission from $H^-(1/2)$ was observed at 4071 Å corresponding to its predicted binding energy of $3.0468\ eV$ with the fine structure and its predicted bound-free hyperfine structure lines $E_{HF} = j^2 3.00213\ X 10^{-5} + 3.0563\ eV$ (j is an integer) that matched for $j = 1$ to $j = 37$ to within a 1 part per 10^4,[39]

28.) the observation of stationary inverted H Balmer and Lyman populations from a low pressure water-vapor microwave discharge plasma with an overpopulation sufficient for lasing at wavelengths over a wide range from micron to blue wherein molecular oxygen served as the catalyst as supported by O^{2+} emission and H Balmer line broadening of 55 eV compared to 1 eV for hydrogen alone,[40]

29.) the observation of H Balmer line broadening of 55 eV compared to 1 eV for hydrogen alone at distances up to 5 cm from the coupler,[41]

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[37] Ref. Nos. 39, 42, 46, 57, 81, 89, 91
[38] Ref. Nos. 39, 42, 46, 57, 81, 89, 91
[39] Ref. Nos. 39, 42, 46, 51, 54, 55, 57, 81, 89, 91
[40] Ref. Nos. 59, 65-66, 68, 74, 83, 85
[41] Ref. No. 74

30.) the observation that with a microwave input power of $9\ W \cdot cm^{-3}$, a collisional radiative model showed that the hydrogen excited state population distribution was consistent with an $n = 1 \rightarrow 5,6$ pumping power of an unprecedented $200\ W \cdot cm^{-3}$ permissive of gas laser efficiencies orders of magnitude those of conventional visible gas lasers and direct generation of electrical power using photovoltaic conversion of the spontaneous or stimulated water vapor plasma emission,[42]

31.) the observation of stimulation of the stationary inverted H Balmer population from a low pressure water-vapor microwave discharge plasma by back illumination with an infrared source that showed depopulation of the $n = 5$ state,[43]

32.) the observation of stationary inverted H Balmer and Lyman populations from a low pressure water-vapor microwave discharge plasma with an overpopulation sufficient for lasing was observed for Evenson microwave plasmas, but not for RF or discharge plasmas,[44]

33.) the observation of stationary inverted H Balmer and Lyman populations from a low pressure water-vapor microwave discharge plasma with an overpopulation sufficient for lasing that was dependent on the microwave plasma source with the highest inversion from Evenson microwave plasmas,[45]

34.) the observation of stationary inverted H Balmer and Lyman populations from a low pressure water-vapor microwave discharge plasma with an overpopulation sufficient for lasing that was dependent on the pressure of the Evenson microwave plasma,[46]

35.) the observation of stationary inverted H Balmer populations from a low pressure water-vapor microwave discharge plasma with an overpopulation sufficient for lasing at distances up to 5 cm from the coupler,[47]

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[42] Ref. Nos. 68, 83, 85
[43] Ref. Nos. 59, 65, 68, 85
[44] Ref. Nos. 59, 65-66, 68, 73, 83, 85
[45] Ref. No. 83
[46] Ref. Nos. 59, 68, 73, 83, 85
[47] Ref. No. 74

36.) the observation that the requirement for the natural hydrogen-oxygen stoichiometry of the Evenson water plasma was stringent in that a deviation by over 2% excess of either gas caused a reversal of the H inversion in water vapor plasmas,[48]

37.) the observation of a typical slow H population for a water-vapor plasma maintained in a GEC-type cell that was independent of time, and a new phenomenon, an extraordinary fast population that increased from zero to a significant portion of the Balmer α emission with time under no-flow conditions wherein the peak width and energy increased with time up to a 0.7 nm half-width corresponding to an average hydrogen atom energy of 200 eV,[49]

38.) the observation of a substantial fast H population (~20% at 40 eV) for a water-vapor plasmas maintained in a GEC-type cell that was independent of position including regions were the electric field was orders of magnitude to low to explain the extraordinarily high Doppler energies,[50]

39.) the observation of fast H population (40-50 eV) for He/H_2 (95/5%), Ar/H_2 (95/5%), and H_2 plasmas maintained in a GEC-type cell that was independent of position including regions were the electric field was orders of magnitude to low to explain the extraordinarily high Doppler energies,[51]

40.) the observation of the features of excessive H broadening that can not be explained by field-acceleration models such as an isotropic effect (broadening is independent of position in the cell or observation direction relative to the applied-field direction, selective H broadening, lack of a requirement for a divertor or reflector, time dependence, lack of an applied-field or pressure dependence over a broad range, and the observation that only particular hydrogen-mixed plasmas show the extraordinary broadening,[52]

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[48] Ref. Nos. 59, 68, 83, 85
[49] Ref. No. 95
[50] Ref. No. 96
[51] Ref. Nos. 92, 93, 97, 105
[52] Ref. No. 114

41.) the observation by the Institut für Niedertemperatur-Plasmaphysik e.V. of an anomalous plasma and plasma afterglow duration formed with hydrogen-potassium mixtures,[53]

42.) the observation of anomalous afterglow durations of plasmas formed by catalysts providing a net enthalpy of reaction within thermal energies of $m \cdot 27.28\ eV$,[54]

43.) the formation of a chemically generated hydrogen plasma with the observation of Lyman series in the EUV that represents an energy release about 10 times that of hydrogen combustion which is greater than that of any possible known chemical reaction,[55]

44.) the observation of line emission by the Institut für Niedertemperatur-Plasmaphysik e.V. with a 4° grazing incidence EUV spectrometer that was 100 times more energetic than the combustion of hydrogen,[56]

45.) the excessive increase in the Lyman emission upon the addition of helium or argon catalyst to a hydrogen plasma,[57]

46.) the observation of the characteristic emission from Sr^{+} and Sr^{3+} that confirmed the resonant nonradiative energy transfer of $2 \cdot 27.2\ eV$ from atomic hydrogen to Sr^{+},[58]

47.) the observation of anomalous plasmas formed with Sr and Ar^{+} catalysts at 1% of the theoretical or prior known voltage requirement with a light output per unit power input up to 8600 times that of the control standard light source,[59]

48.) the observation that the optically measured output power of gas cells for power supplied to the glow discharge increased by over two orders of magnitude depending on the presence of less than 1% partial pressure of certain catalysts in hydrogen gas or argon-

[53] Ref. Nos. 13, 47, 81
[54] Ref. Nos. 12, 13, 47, 81
[55] Ref. Nos. 11-13, 15-16, 20, 24, 27, 32, 39, 42, 46-47, 51-52, 54-55, 57, 72, 81, 89, 91, 109
[56] Ref. No. 14
[57] Ref. Nos. 20, 31, 37, 43
[58] Ref. Nos. 16, 52
[59] Ref. Nos. 11, 16, 20, 23, 52, 72

hydrogen gas mixtures, and an excess thermal balance of 42 W was measured for the 97% argon and 3% hydrogen mixture versus argon plasma alone,[60]

49.) the observation that glow discharge plasmas of the catalyst-hydrogen mixtures of strontium-hydrogen, helium-hydrogen, argon-hydrogen, strontium-helium-hydrogen, and strontium-argon-hydrogen showed significant Balmer α line broadening corresponding to an average hydrogen atom temperature of $25-45\ eV$; whereas, plasmas of the noncatalyst-hydrogen mixtures of pure hydrogen, krypton-hydrogen, xenon-hydrogen, and magnesium-hydrogen showed no excessive broadening corresponding to an average hydrogen atom temperature of $\approx 3\ eV$,[61]

50.) the observation that microwave helium-hydrogen and argon-hydrogen plasmas having catalyst Ar^+ or He^+ showed extraordinary Balmer α line broadening due to hydrogen catalysis corresponding to an average hydrogen atom temperature of $110-130\ eV$ and $180-210\ eV$, respectively; whereas, plasmas of pure hydrogen, neon-hydrogen, krypton-hydrogen, and xenon-hydrogen showed no excessive broadening corresponding to an average hydrogen atom temperature of $\approx 3\ eV$,[62]

51.) the observation that microwave helium-hydrogen and argon-hydrogen plasmas showed average electron temperatures that were high, $30{,}500 \pm 5\%\ K$ and $13{,}700 \pm 5\%\ K$, respectively; whereas, the corresponding temperatures of helium and argon alone were only $7400 \pm 5\%\ K$ and $5700 \pm 5\%\ K$, respectively,[63]

52.) the observation of significant Balmer α line broadening of $17,\ 9,\ 11,\ 14,\ and\ 24\ eV$ from rt-plasmas of incandescently heated hydrogen with K^+ / K^+, Rb^+, cesium, strontium, and strontium with Ar^+ catalysts, respectively, wherein the results could not be explained by Stark or thermal broadening or electric field acceleration of charged species since the measured field of the incandescent heater was extremely weak, 1 V/cm, corresponding to a broadening of much less than $1\ eV$,[64]

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[60] Ref. No. 22
[61] Ref. Nos. 16, 20, 30, 52, 72
[62] Ref. Nos. 33-37, 43, 49, 60, 63-64, 69, 71, 73-74, 82, 84, 88
[63] Ref. Nos. 34-37, 43, 49, 63, 67, 73
[64] Ref. Nos. 39, 42, 46, 51-52, 54-55, 57, 72, 81, 89, 91, 108-109

53.) calorimetric measurement of excess power of 20 mW/cc on rt-plasmas formed by heating hydrogen with K^+ / K^+ and Ar^+ as catalysts,[65]

54.) the observation of an energy balance of $\Delta H = -17{,}925\ kcal / mole\ KNO_3$, about 300 times that expected for the most energetic known chemistry of KNO_3, and $-3585\ kcal / mole\ H_2$, over 60 times the hypothetical maximum enthalpy of $-57.8\ kcal / mole\ H_2$ due to combustion of hydrogen with atmospheric oxygen, assuming the maximum possible H_2 inventory when KNO_3 and Raney nickel were used as a source of K catalyst and atomic hydrogen, respectively, to produce the corresponding exothermic reaction,[66]

55.) the observation of rt-plasmas formed with strontium and argon at 1% of the theoretical or prior known voltage requirement with a light output per unit power input up to 8600 times that of the control standard light source as well as an excess power of 20 mW/cm from rt-plasmas formed by Ar^+ as the catalyst in an incandescent-filament cell,[67]

56.) the Calvet calorimetry measurement of an energy balance of over $-151{,}000\ kJ / mole\ H_2$ with the addition of 3% hydrogen to a plasma of argon having the catalyst Ar^+ compared to the enthalpy of combustion of hydrogen of $-241.8\ kJ / mole\ H_2$; whereas, under identical conditions no change in the Calvet voltage was observed when hydrogen was added to a plasma of noncatalyst xenon,[68]

57.) the observation that the power output exceeded the power supplied to hydrogen glow discharge plasmas by 35-184 W depending on the presence of catalysts from helium or argon and less than 1% partial pressure of strontium metal in noble gas-hydrogen mixtures; whereas, the chemically similar noncatalyst krypton had no effect on the power balance,[69]

58.) the observation that with the addition of 3% flowing hydrogen to an argon microwave plasma with a constant input power of $40\ W$, the gas temperature increased from 400°C to over 750°C; whereas, the 400°C temperature of a xenon plasma run under identical conditions was essentially unchanged with the addition of hydrogen,[70]

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[65] Ref. Nos. 39, 81, 89, 108
[66] Ref. No. 111
[67] Ref. Nos. 72, 109
[68] Ref. No. 31
[69] Ref. No. 30
[70] Ref. No. 43

59.) observations of power such as that where the addition of 10% hydrogen to a helium microwave plasma maintained with a constant microwave input power of $40\ W$, the thermal output power was measured to be at least $280\ W$ corresponding to a reactor temperature rise from room temperature to 1200°C within 150 seconds, a power density of $28\ MW/m^3$, and an energy balance of at least $-4\ X10^5\ kJ/mole\ H_2$ compared to the enthalpy of combustion of hydrogen of $-241.8\ kJ/mole\ H_2$,[71]

60.) the observation of $306 \pm 5\ W$ of excess power generated in $45\ cm^3$ by a compound-hollow-cathode-glow discharge of a neon-hydrogen (99.5/0.5%) mixture corresponding to a power density of $6.8\ MW/m^3$ and an energy balance of at least $-1\ X10^6\ kJ/mole\ H_2$ compared to the enthalpy of combustion of hydrogen of $-241.8\ kJ/mole\ H_2$,[72]

61.) the observation that for an input of 37.7 W, the total plasma power of the neon-hydrogen plasma measured by water bath calorimetry was 60.7 W corresponding to 23.0 W of excess power in 3 cm^3,[73]

62.) the observation of intense He^+ emission and a total plasma power of a helium-hydrogen plasma measured by water bath calorimetry of 30.0 W for an input of 8.1 W, corresponding to 21.9 W of excess power in 3 cm^3 wherein the excess power density and energy balance were high, $7.3\ W/cm^3$ and $-2.9\ X10^4\ kJ/mole\ H_2$, respectively,[74]

63.) in the comparison of helium-hydrogen plasmas sources, the observation that i.) with an input power of 24.8± 1 W, the total plasma power of the Evenson microwave helium-hydrogen plasma measured by water bath calorimetry was 49.1 ± 1 W corresponding to 24.3 ± 1 W of excess power in 3 cm^3 corresponding to a high excess power density and energy balance of $8.1\ W/cm^3$ and over $-3\ X10^4\ kJ/mole\ H_2$, respectively, ii.) with an input of 500 W, a total power of 623 W was generated in a 45 cm^3 compound-hollow-cathode-glow discharge, iii.) less than 10% excess power was observed from inductively coupled RF helium-hydrogen plasmas, and iv.) no measurable heat was observed from MKS/Astex

[71] Ref. Nos. 34, 35
[72] Ref. Nos. 50, 78
[73] Ref. No. 76
[74] Ref. Nos. 36, 63, 71, 73

microwave helium-hydrogen plasmas that corresponded to the absence of H Balmer line broadening, [75]

64.) the observation of energy balances of helium-hydrogen microwave plasmas of over 100 times the combustion of hydrogen and power densities greater than $10\ W/cm^3$ measured by water bath calorimetry,[76]

65.) at the load matching condition of 600 Ω, the direct plasmadynamic conversion (PDC) of open circuit voltages of 11.5 V and ~200 mW of electrical power with a 0.125 in diameter by 3/4 in long plasmadynamic electrode and a 140 G applied field corresponding to an extracted power density of ~1.61 W/cm^3 and an efficiency of ~18.8%,[77]

66.) at the load matching condition of 250 Ω, the direct plasmadynamic conversion (PDC) of open circuit voltages of 21.8 V and 1.87 W of electrical power with a 0.125 in diameter by 3/4 in long plasmadynamic electrode and a 140 G applied field corresponding to an extracted power density of 3.6 W/cm^3 and an efficiency of 42%,[78]

67.) the projection that the generation of electricity using magnetohydrodynamic (MHD) conversion of the plasma particle energy of small to mid-size chemically assisted microwave or glow discharge plasma (ca-plasma) power sources in the range of a few hundred Watts to several 10's of kW for microdistributed commercial applications appears feasible at 50% efficiency or better with a simple compact design,[79]

68.) the differential scanning calorimetry (DSC) measurement of minimum heats of formation of KHI by the catalytic reaction of K with atomic hydrogen and KI that were over $-2000\ kJ/mole\ H_2$ compared to the enthalpy of combustion of hydrogen of $-241.8\ kJ/mole\ H_2$,[80]

[75] Ref. Nos. 84, 98, 104
[76] Ref. Nos. 34-36, 50, 63, 71, 73, 76-78, 84, 92, 93, 101, 112
[77] Ref. No. 48
[78] Ref. No. 56
[79] Ref. No. 40
[80] Ref. No. 25

69.) the isolation of novel hydrogen compounds as products of the reaction of atomic hydrogen with atoms and ions which formed an anomalous plasma as reported in the EUV studies,[81]

70.) the synthesis and identification of a novel diamond-like carbon film terminated with $CH(1/p)$ ($H^{*}DLC$) comprising high binding energy hydride ions was synthesized for the first time from solid carbon by a microwave plasma reaction of a mixture of 10-30% hydrogen and 90-70% helium wherein He^{+} served as a catalyst with atomic hydrogen to form the highly stable hydride ions and an energetic plasma,[82]

71.) the synthesis of polycrystalline diamond films on silicon substrates without diamond seeding by a very low power microwave plasma reaction of a mixture of helium-hydrogen-methane (48.2/48.2/3.6%) wherein He^{+} served as a catalyst with atomic hydrogen to form an energetic plasma with an average hydrogen atom temperature of $180-210\ eV$ versus $\approx 3\ eV$ for pure hydrogen and bombardment of the carbon surface by highly energetic hydrogen formed by the catalysis reaction may play a role in the formation of diamond,[83]

72.) the synthesis of polycrystalline diamond films on silicon substrates without diamond seeding by a very low power microwave plasma reaction of a mixture of argon-hydrogen-methane (17.5/80/2.5%) wherein Ar^{+} served as a catalyst with atomic hydrogen to form an energetic plasma with an average hydrogen atom temperature of $110-130\ eV$ versus $\approx 3\ eV$ for pure hydrogen and bombardment of the carbon surface by highly energetic hydrogen formed by the catalysis reaction may play a role in the formation of diamond,[84]

73.) the identification of a novel highly stable surface coating $SiH(1/p)$ by time of flight secondary ion mass spectroscopy that showed SiH^{+} in the positive spectrum and H^{-} dominant in the negative spectrum and by X-ray photoelectron spectroscopy which showed that the H content of the SiH coatings was hydride ions, $H^{-}(1/4)$, $H^{-}(1/9)$, and $H^{-}(1/11)$ corresponding to peaks at 11, 43, and 55 eV, respectively, and showed that the surface was remarkably stable to air,[85]

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[81] Ref. Nos. 6-10, 19, 25, 38, 41, 44-45, 60-62, 75, 81, 87, 90, 92, 93, 100, 101, 108, 110-112
[82] Ref. No. 60
[83] Ref. Nos. 64, 69, 88
[84] Ref. Nos. 82, 88
[85] Ref. Nos. 45, 61, 100

74.) the isolation of novel inorganic hydride compounds such as $KHKHCO_3$ and KH following each of the electrolysis and plasma electrolysis of a K_2CO_3 electrolyte which comprised high binding energy hydride ions that were stable in water with their identification by methods such as (i) ToF-SIMS on $KHKHCO_3$ which showed inorganic hydride clusters $K[KHKHCO_3]_n^+$ and a negative ToF-SIMS dominated by hydride ion, (ii) X-ray photoelectron spectroscopy which showed novel peaks corresponding to high binding energy hydride ions, and (iii) ^1H nuclear magnetic resonance spectroscopy which showed upfield shifted peaks corresponding to more diamagnetic, high-binding-energy hydride ions,[86]

75.) the identification of $LiHCl$ comprising a high binding energy hydride ion by time of flight secondary ion mass spectroscopy which showed a dominant H^- in the negative ion spectrum, X-ray photoelectron spectroscopy which showed $H^-(1/4)$ as a new peak at its predicted binding energy of 11 eV, ^1H nuclear magnetic resonance spectroscopy which showed an extraordinary upfield shifted peak of -15.4 ppm corresponding to the novel hydride ion, and powder X-ray diffraction which showed novel peaks,[87]

76.) the identification of novel hydride compounds by a number of analytical methods such as (i) time of flight secondary ion mass spectroscopy which showed a dominant hydride ion in the negative ion spectrum, (ii) X-ray photoelectron spectroscopy which showed novel hydride peaks and significant shifts of the core levels of the primary elements bound to the novel hydride ions, (iii) ^1H nuclear magnetic resonance spectroscopy (NMR) which showed extraordinary upfield chemical shifts compared to the NMR of the corresponding ordinary hydrides, and (iv) thermal decomposition with analysis by gas chromatography, and mass spectroscopy which identified the compounds as hydrides,[88]

77.) the NMR identification of novel hydride compounds $MH*X$ wherein M is the alkali or alkaline earth metal, X, is a halide, and $H*$ comprises a novel high binding energy hydride ion identified by a large distinct upfield resonance,[89]

78.) the replication of the NMR results of the identification of novel hydride compounds by large distinct upfield resonances at Spectral Data Services, University of Massachusetts

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[86] Ref. Nos. 6-7, 9, 38, 41
[87] Ref. Nos. 44, 62
[88] Ref. Nos. 6-10, 19, 25, 38, 41, 44-45, 60-62, 75, 81, 87, 90, 92, 93, 100, 108, 110-112
[89] Ref. Nos. 10, 19, 41, 44, 62, 81, 108, 110-112

Amherst, University of Delaware, Grace Davison, and National Research Council of Canada,[90]

79.) the NMR identification of novel hydride compounds $MH*$ and MH_2^* wherein M is the alkali or alkaline earth metal and $H*$ comprises a novel high binding energy hydride ion identified by a large distinct upfield resonance that proves the hydride ion is different from the hydride ion of the corresponding known compound of the same composition, [91]

80.) the observation that the ^1H MAS NMR spectrum of novel compound $KH*Cl$ relative to external tetramethylsilane (TMS) showed a large distinct upfield resonance at -4.4 corresponding to an absolute resonance shift of -35.9 ppm that matched the theoretical prediction of p = 4, and the novel peak of $KH*I$ at -1.5 ppm relative to TMS corresponding to an absolute resonance shift of -33.0 ppm matched the theoretical prediction of p = 2,[92]

81.) the observation that the predicted catalyst reactions, position of the upfield-shifted NMR peaks, and spectroscopic data for $H^-(1/2)$ and $H^-(1/4)$ were found to be in agreement,[93]

82.) the analysis by Infrared (FTIR) spectroscopy which eliminated any known explanation such as U centered H for the assignment of the extraordinary upfield-shifted NMR peak.[94]

83.) the isolation of fraction-principal-quantum-level molecular hydrogen $H_2(1/p)$ gas by liquefaction using an ultrahigh-vacuum, liquid nitrogen cryotrap, and the observations of novel peaks by cryogenic gas chromatography, a higher ionization energy than H_2 by mass spectroscopy, a substantial change in the EUV emission spectrum with deuterium substitution in a region where no hydrogen emission has ever been observed, and upfield shifted NMR peaks at 0.21, 2.18 and 3.47 ppm compared to that of H_2 at 4.63 ppm,[95]

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[90] Ref. Nos. 19, 81, 108, 110
[91] Ref. Nos. 19, 81, 108, 110-112
[92] Ref. Nos. 81, 108, 110-112
[93] Ref. Nos. 81, 108, 110-112
[94] Ref. Nos. 108, 110-112
[95] Ref. Nos. 75, 87, 90, 92, 93, 94, 101, 112

84.) the observation of ^1H NMR singlet peaks upfield of H_2 with a predicted integer spacing of 0.64 ppm at 3.47, 3.02, 2.18, 1.25, 0.85, and 0.22 ppm identified as the consecutive series $H_2(1/2)$, $H_2(1/3)$, $H_2(1/4)$, $H_2(1/5)$, $H_2(1/6)$, and $H_2(1/7)$, respectively, and $H_2(1/10)$ at -1.8 ppm wherein $H_2(1/p)$ gas was isolated by liquefaction at liquid nitrogen temperature, by decomposition of compounds found to contain the corresponding hydride ions $H^-(1/p)$, and by permeation through a hollow nickel cathode,[96]

85.) the observation of excess enthalpy from a K_2CO_3 electrolytic cell of a factor of two times that of the resistive power dissipation and ^1H NMR singlet peaks upfield of H_2 with a predicted integer spacing of 0.64 ppm at 3.49, 2.17, 1.25, 0.86, and 0.21 ppm which matched the consecutive series $H_2(1/2)$, $H_2(1/4)$, $H_2(1/5)$, $H_2(1/6)$, and $H_2(1/7)$, respectively, and a higher ionizing molecular hydrogen recorded on the electrolysis gases collected in a hollow nickel cathode,[97]

86.) the observation of 1943 cm^{-1} and 2012 cm^{-1} peaks in the high-resolution (0.5 cm^{-1}) FTIR spectrum (490-4000 cm^{-1}) of $KH*I$ having a peak assigned to $H^-(1/4)$ that matched the predicted frequencies of ortho and para-$H_2(1/4)$,[98]

87.) the observation of the 1943/2012 cm^{-1}-peak-intensity ratio of 3:1 in the high resolution (0.5 cm^{-1}) FTIR spectrum (1875-2060 cm^{-1}) of $KH*I$ which is characteristic of ortho-para hydrogen splitting wherein the ortho-para splitting of 69 cm^{-1} matched that predicted,[99]

88.) the observation of rotational lines in the 145-300 nm region from atmospheric pressure 12.5 keV electron-beam excited argon-hydrogen plasmas where the unprecedented energy spacing of 4^2 times that of hydrogen established the internuclear distance as 1/4 that of H_2 and identified $H_2(1/4)$,[100]

89.) the observation of emission from 12.5 keV-electron-beam-excited $KH*Cl$ having $H^-(1/4)$ by NMR that matched the rotational emission lines of interstitial $H_2(1/4)$ and further

[96] Ref. Nos. 98, 101, 103-104, 112
[97] Ref. Nos. 103-104
[98] Ref. Nos. 110-112
[99] Ref. Nos. 110-112
[100] Ref. Nos. 98, 101, 104, 110-112

matched the rotational frequency of $H_2(1/4)$ observed by FTIR and by electron-beam excitation of the argon-hydrogen plasmas.[101]

Applicant again respectfully demands that the Secret Committee consider and evaluate in detail all of this record evidence, which, to date, it has largely ignored. The scientific data disclosed in this extensive body of evidence was collected and peer-reviewed with great care by a group of highly qualified scientists capable of understanding every detail of Applicant's technology. The very least the Committee can do is to also carefully evaluate that data in detail, article by article, with an open mind so that Applicant is given a full and fair opportunity to present his case. If and when the Committee finally does so, Applicant believes it will find that the evidence overwhelmingly proves the existence of lower-energy hydrogen in accordance with his disclosed invention.

If, on the other hand, the Committee should find true fault with any of that data on legitimate scientific grounds—not the kind of nitpicking Applicant has seen on theoretical grounds—it should communicate as much to afford Applicant the opportunity to respond. Such scientific give-and-take is the only way to advance the prosecution of this case.

Unfortunately, with continued prosecution of this and BlackLight's other applications, a far different pattern has emerged. The Committee continues to set arbitrary and capricious hurdles designed to avoid considering Applicant's conclusive experimental evidence and thereby block his patents from issuing. Each time Applicant clears one of these hurdles, the Committee merely raises the bar by setting new standards.

For instance, the Committee initially alleged that Applicant's disclosed hydrogen chemistry, which forms lower-energy hydrogen, related to the controversial concepts of "perpetual motion" and "cold fusion." When Applicant exposed those allegations as utter nonsense, the Committee quickly abandoned its indefensible position, arguing instead that BlackLight's lower-energy hydrogen technology violated unidentified laws of physics. Then, to cover up its failure to identify even a <u>single</u> physical law that was

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[101] Ref. Nos. 111-112

supposedly being violated, the Committee improperly placed the burden on Applicant to do so: "in order to establish enablement, applicant bears the burden of providing the accepted scientific laws wrong or incomplete." When Applicant showed that just the opposite is true—that Applicant's novel hydrogen chemistry complies with all physical laws, even at atomic and sub-atomic levels—the Committee once again backpedaled. The Committee then advanced vague assertions that Applicant's lower-energy hydrogen violated "ideas" of modern science and, later, that his technology contradicted "beliefs" in the scientific community.

The only consistency found throughout this myriad of contrived standards is the Committee's use of each to excuse it from fairly considering and evaluating Applicant's scientific evidence that lower-energy hydrogen does indeed exist. Instead, the Committee prefers engaging in a theoretical debate to the exclusion of that evidence, pitting its favored quantum theory, with all of its far-fetched and disproved predictions, against Applicant's theory of classical quantum mechanics that correctly predicts the formation of lower-energy hydrogen.

Applicant has willingly engaged the Committee in this theoretical debate, and will continue to do so if necessary, even though the patent laws do not require that an inventor understand the precise theoretical basis for why his invention works. All the law requires is that he disclose his invention in sufficient detail to enable one of ordinary skill in the art how to practice it. Applicant has done precisely that and the Committee has failed in its burden to show otherwise.

Of course, the debate over these competing theories can go on indefinitely without resolution, which may be the Committee's strategy. Engaging in that intellectual exercise, however, will not—indeed cannot—definitively settle the question of whether practicing Applicant's disclosed hydrogen chemistry results in the formation of lower-energy hydrogen. Like any good theoretical debate, this one can only be tested and ultimately settled by fully and fairly evaluating the unprecedented amount of real-world experimental evidence Applicant has submitted conclusively confirming the lower energy states of hydrogen. Applicant has expended tens of millions of dollars amassing this experimental evidence. The least the Committee can do is properly consider it.

Instead, the Committee, consistent with its "allowance is not an option policy," has now taken an even more extreme erroneous position, based on the biased views of its most recent member, Dr. Souw, that all of Applicant's evidence actually "detract[s] from the central issue that the hydrino does not theoretically exist." [See, e.g., May 12, 2004 Advisory Action issued in U.S. App'n Ser. No. 09/669,877 at page 2 (emphasis added).] Out of the multitude of baseless arguments that the Committee has put forward, this one truly stands out as perhaps the most outrageous.

Applicant has spent enormous amounts of effort and money complying with the PTO's unlawful requirement that he publicly disclose his confidential data in peer-reviewed publications to prove the existence of lower-energy hydrogen. Now, incredibly, Applicant is being told that those efforts have been for naught since, according to the Committee, "all of applicant's data cannot prove what is not theoretically possible." [Id. at page 2.]

The Committee's position, however, that it need not seriously analyze Applicant's scientific data because the existence of lower-energy hydrogen is so incredible as to be theoretically impossible—at least according to its misguided view of quantum mechanics—violates well-established patent laws and procedures. Indeed, the PTO's own procedures outlined in MPEP § 2107, p. 2100-31 require that the Examiner not start from the premise that an invention is "incredible," by mandating that:

> [The Examiner] should not begin an evaluation of utility by assuming that an asserted utility is likely to be false, based on the technical field of the invention or for other general reasons. . . A conclusion that an asserted utility is incredible can be reached only after the Office has evaluated both the assertion of the applicant regarding utility and any evidentiary basis of that assertion. The [Examiner] should be particularly careful not to start with a presumption that an asserted utility is, *per se*, "incredible" and then proceed to base a rejection under 35 U.S.C. 101 on that presumption.

When Applicant first criticized the Committee's error in refusing to consider Applicant's supporting evidence, under the presumption that the utility of his novel hydrogen technology is *per se* incredible, the Committee vehemently denied that it had

ever taken the position that the existence of lower-energy hydrogen was impossible. For instance, the Committee's most prominent member, Dr. Souw, tried claiming that:

> Contrary to Applicant's allegation on pg. 13, 1st full paragraph, lines 2-4, the PTO's view is not at all that the existence of lower-energy hydrogen were [sic] impossible, but instead, that (a) Applicant's invention is not supported by any experimental fact or evidence, and (b) the underlying theory (i.e., GUT/CQM) fails to support the invention, because it contains too many flaws. [Souw Appendix at p. 3 attached to the Committee's Final Office Action mailed August 24, 2004 in Applicant's U.S. Ser. No. 08/467,051 (emphasis added).]

After Applicant exposed the disingenuousness of those denials, the Committee has now at least finally dropped all pretenses and readily admits that it has dismissed the totality of Applicant's submitted scientific evidence based on the presumption that Applicant's pioneering technology is impossible. Applicant is hard pressed to imagine an approach to patent examination any more arbitrary and capricious than that.

As Applicant has consistently argued, the only way to settle the theoretical argument on whether lower-energy hydrogen actually exists is to properly evaluate the real-world evidence that Applicant and independent third parties have generated. For the Committee to now assert that this real-world evidence "detract[s] from the central issue that the hydrino does not theoretically exist" turns science on its head and is an embarrassment to a government agency charged with "promot[ing] the Progress of Science and useful Arts." [See U.S. Constitution, Art. I, Sect. 8, Clause 8.]

In the few isolated instances in which the Committee has addressed Applicant's evidence, it offers far-fetched reasons for dismissing it without a fair hearing, again demonstrating its arbitrary and capricious approach to examination of his cases. One prominent example occurred during the February 21, 2001 Interview held in all of BlackLight's then-pending lower-energy hydrogen applications, which was led by Examiner Vasudevan Jagannathan—one of the few Committee members Applicant has been able to successfully identify. At that interview, Applicant had a brief opportunity to present some of his scientific evidence, including spectroscopic data that is extraordinarily reliable in identifying chemical compositions. Such data amounts to a "chemical fingerprint" that cannot be seriously disputed. Despite the conclusiveness of

that evidence, Examiner Jagannathan dismissed it out of hand as nothing more than "a bunch of squiggly lines."

To put the absurdity of that comment in context, the PTO rationalized its withdrawal of BlackLight's five allowed patent applications, in part, by citing a January 12, 2000 article written by Dr. Robert Park, spokesman for one of Applicant's main competitors, the American Physical Society (APS). [March 22, 2000 Decision at page 7 (Attachment G)] In that article, Dr. Park made the following startling statements:

> The energy states of atoms are studied through their atomic spectra—light emitted at very specific wavelengths when electrons make a jump from one energy level to another. <u>The exact prediction of the hydrogen spectrum was one of the first great triumphs of quantum theory; it is the platform on which our entire understanding of atomic physics is built. The theory accounts perfectly for every spectral line</u>.
>
> <u>There is no line corresponding to a "hydrino" state. Indeed there is no credible evidence at all to support Mills' claim</u>. [See Attachment J (emphasis added)]

The incredible irony here—one that cannot be easily overlooked—highlights once again the extreme arbitrary and capricious approach the Committee has taken in examining this and other BlackLight applications. There is no question that the vitriol espoused by Dr. Park in his cited *Post* article was, at least, partially responsible for the PTO's suspect withdrawal of the five allowed BlackLight applications from issue. And yet, despite the fact that the very article the PTO relies upon to deny Applicant his patents recognizes that spectroscopic data is extraordinarily reliable—indeed, the "platform on which our <u>entire</u> understanding of atomic physics is built"—the Committee nonetheless continues to cavalierly ignore or dismiss that same data when submitted by Applicant.

Out of exasperation, Applicant queried Examiner Jagannathan during the February 21, 2001 Interview as to what type and quality of evidence would convince him that lower-energy hydrogen exists. In response, the Examiner required that Applicant publicly divulge confidential information by publishing his experimental evidence in peer-reviewed scientific journals for that evidence to be considered reliable. As detailed above, Applicant has more than met this newly created "publication" standard for

considering his experimental evidence by submitting over 100 scientific papers for publication, even though the PTO's rules and procedures impose no such requirement. So far, over 60 of these papers have completed and passed the peer-review process conducted by highly qualified Ph.D. referees.

Applicant's experimental evidence has been extensively peer-reviewed and published in the following esteemed journals:

Applied Physics Letters
Chemistry of Materials
Electrochimica Acta
European Journal of Physics D
European Physical Journal: Applied Physics
Fusion Technology Journal of New Materials for Electrochemical Systems
IEEE Transactions on Plasma Science
International Journal of Hydrogen Energy
Journal of Applied Physics[102]
Journal of Material Science
Journal of Molecular Structure
Journal of Optical Materials
Journal of Plasma Physics
Journal of Physics D: Applied Physics
Journal of Quantitative Spectroscopy and Radiative Transfer
Journal of New Materials for Electrochemical Systems
New Journal of Physics
Physics Essays
Plasma Sources Science and Technology
Solar Energy Materials & Solar Cells
Thermochimica Acta
Vibrational Spectroscopy

Additionally, Applicant's experimental evidence has been submitted for peer-review and publication in the following esteemed journals:

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[102] Applicant notes that the *Journal of Applied Physics* is the very same journal cited by the Committee as credible evidence that Dr. Souw, one of its premier members, is supposedly qualified to evaluate Applicant's novel hydrogen technology. [See *infra*.]

Acta Physica Polonica A

AIAA Journal

Anuoles de la Fondation Louis de Broglie

Brazilian Journal of Physics

Canadian Journal of Physics

Central European Journal of Physics

Chemical Engineering Science

Contributions to Plasma Physics

Current Applied Physics

Europhysics Letters

Fizika A

Foundations of Science

Journal of Applied Spectroscopy

Journal of Mathematical Physics

Journal of Materials Research

Journal of Physical Chemistry A

Journal of Physical Chemistry B

Journal of Vacuum Science & Technology A

Materials Characterization

Materials Chemistry and Physics

New Journal of Chemistry

Physical Review B

Physica Scripta

Spectrochimica Acta Part B: Atomic Spectroscopy

Thin Solid Films

Vacuum

Once again, however, the Secret Committee has raised the bar to patentability by arbitrarily and capriciously ignoring this vast body of evidence that it required Applicant to submit. The Committee apparently believes that its anonymous members are better qualified than the numerous skilled PhD's who peer-reviewed and approved the contents of Applicant's articles confirming the existence of lower-energy hydrogen.

The PTO's mishandling of the experimental evidence of record in this case is but one of several improper actions that have adversely effected Applicant's patent rights. Others include:

(1) illegally withdrawing or threatening to withdraw other copending BlackLight patent applications from issue, after initially allowing all claims, under highly suspicious circumstances that suggest likely interference by BlackLight's competitors;

(2) improperly examining this application by Secret Committee, effectively denying Applicant the right to confront the persons involved in that examination, to assess their qualifications and biases, and to ascertain whether those persons include BlackLight's competitors or other improper outside influences, in breach of PTO confidentiality requirements; and

(3) refusing reasonable requests by Applicant and five U.S. Senators to divulge information relating to the events that triggered the PTO's withdrawal action, and the identity of all PTO employees and non-PTO personnel involved in examining BlackLight's applications.

These improper actions bear directly upon the prosecution of BlackLight's pending applications, yet Applicant's good faith efforts to discuss and resolve these and other outstanding issues have been either ignored or rejected out of hand. One of Applicant's many overtures was communicated directly to then PTO Director James E. Rogan in a letter dated December 21, 2001, from BlackLight board member Dr. Shelby T. Brewer. Dr. Brewer received his Ph.D. in Nuclear Engineering from M.I.T. and served as Assistant Energy Secretary in the Reagan administration. [See Attachment A]

As stated in his letter, Dr. Brewer's reasons for appealing to Director Rogan were motivated not only by his fiduciary duty to protect BlackLight's interests, but also by a sincere desire to avoid unnecessary embarrassment to the PTO over these lingering issues if left unresolved. Dr. Brewer appealed for a meeting with Director Rogan in an attempt to bring some closure to this matter in a way that might mutually benefit both sides.

Despite the urgency of his plea, Dr. Brewer waited over four months before finally receiving a response to his request for a meeting. In a curt letter dated April 24, 2002, from the Director's Chief-of-Staff, Jason C. Roe, the PTO advised: "We appreciate your

interest in this matter, but, unfortunately, must decline your request for a meeting due to the fact that the USPTO is not in a position to discuss the issue at the present time." [See Attachment A] The PTO's response, however, merely begs the question: if not now, when will it be in a position to have these discussions?

This negative response, while disappointing, was hardly surprising. In refusing to meet with Applicant, the PTO continues to treat prosecution of this and BlackLight's other copending cases as an adversarial proceeding. While the PTO may believe it is justified in shrouding its untoward actions under a cloak of secrecy and remaining answerable to no one, that approach does little to preserve public confidence in the patent process. Only by openly engaging Applicant in mutually beneficial discussions of all the issues in this case can the PTO ever hope to achieve that worthy goal. Applicant therefore implores the PTO to reconsider its policies and adopt a more flexible and cooperative approach by agreeing to meet with Applicant to discuss the handling of this and other pending BlackLight applications before taking any further action.

Perhaps the PTO sees no need to modify its approach, buoyed by the Federal Circuit's June 28, 2002 Decision upholding its withdrawal action that cancelled issuance of BlackLight's allowed patent applications. *See BlackLight Power, Inc. v. Director James E. Rogan*, 63 USPQ2d1534 (Fed. Cir. June 28, 2002) [Attachment B]. The Federal Circuit ruled, among other things, that an "emergency situation" trumped the controlling regulation requiring the PTO to determine the unpatentability of one or more claims before it withdrew the '294 application from issue so that the PTO's mere "concern" over patentability provided adequate basis for the withdrawal. That Decision, aside from the fact that it is erroneous,[103] does not even begin to resolve other issues that touch on the merits of this case.

[103] Applicant believes that the Federal Court's opinion is erroneous due, in part, to its misreading of a concurring opinion of one Justice in a 38-year-old Supreme Court case to support its holding that this supposed "emergency situation"—a finding that was not supported by the record or even argued by the PTO—justified the PTO's withdrawing BlackLight's copending '294 application from issue on February 17, 2000, after payment of the issue fee. *See BlackLight Power* at page 7 *citing Baltimore & Ohio Railroad Co. v. United States*, 386 U.S. 372, 421 (1964) (Brennan, J., concurring) (recognizing the importance of leaving the Interstate Commerce Commission (ICC) great flexibility to deal with emergency situations to avoid serious damage to the national transportation system, but finding no pressing need that justified the ICC's action). The Federal Circuit stretched that case way beyond the limits of Supreme Court precedent that requires government agencies to strictly follow statutory and regulatory guidelines.

One such issue is how this alleged "emergency situation" arose in the first place, *i.e.*, how the PTO became aware of BlackLight's issued U.S. Patent No. 6,024,935 (the '935 patent) that supposedly raised "concerns" about other pending applications. That issue apparently was not important to Associate Solicitor Kevin Baer who defended the PTO's conduct by arguing to the District Court: "I would even say, Your Honor, you could imagine in our head any scenario of how we learned about it. A blimp flying over us. It doesn't matter, because what matters, Your Honor, is the decision [to withdraw] itself." [May 22, 2000 Transcript at 22 (Attachment K, Tab E)]

Judge Sullivan, however, was apparently unimpressed by those comments, noting in footnote 10 of his opinion that he was "troubled by several steps in the PTO's process" and advising the PTO to "examine its patent issuance process so that their normal operations are not compromised by such seemingly suspicious procedures." [See 109 F.Supp. 2d at 53, n.10 (See Attachment L)]

While the PTO may be unconcerned how it learned of the '935 patent, Applicant considers that information critically important. If, for instance, competitors were somehow involved in events leading to the withdrawal of BlackLight's allowed applications and, perhaps, in the subsequent prosecution of those and other applications, that information would relate directly to the credibility of the rejections entered in those cases, including this one. Applicant therefore renews his request for a full accounting of how, out of the thousands of patents the PTO issues every week, his '935 patent came to its attention, thus leading to the withdrawal of BlackLight's allowed applications.

Incredibly, at oral argument, the PTO did not even suggest that an emergency situation had forced it to withdraw this application from issue on February 17, 2000. To the contrary, PTO Solicitor John M. Whealan argued that <u>no</u> withdrawal—emergency or otherwise—occurred on that date and admitted that, if the Court found otherwise, his case would be seriously compromised. This was because, at that time, the PTO could not locate the patent file and admittedly could not have made a determination of unpatentability of one or more claims as required by the controlling regulation. *See* 37 C.F.R. § 1.131(b)(3); MPEP § 1308 (7^{th} Ed., Rev. 1, Feb. 2000). To avoid an adverse ruling, Solicitor Whealan sought refuge outside the administrative record, suggesting for the first time that the PTO had used the wrong form in mistakenly notifying Applicant on February 17 that his application had been withdrawn. Then, again without evidentiary support, the Solicitor tried to convince a skeptical Court that Director Kepplinger, in consultation with the Examiner, had made an unpatentability determination sometime later, after Applicant had voluntarily supplied the PTO with a copy of the application—hardly an emergency situation if it were true.

Applicant believes that concerns over outside influences on the prosecution of his applications are fully justified. Following the PTO's withdrawal action, counsel immediately investigated the facts and circumstances surrounding that action by questioning various PTO personnel. In discussions with Director Esther Kepplinger, she admitted to counsel that the withdrawal was a reaction to perceived heat—a "firestorm" as she put it—the PTO had received from an undisclosed outside source. Director Kepplinger further indicated that the withdrawal occurred only after BlackLight's '935 patent had been brought to the attention of then-Director Q. Todd Dickinson by Gregory Aharonian, another PTO outsider well known for publicly attacking issued U.S. patents.[104]

Director Kepplinger's revelations are truly disturbing in that they describe what is essentially a newly created non-statutory reexamination procedure for opposing the issuance of patents never envisioned by Congress. *Compare* 35 U.S.C. §§ 301-307 (patent reexamination statutes).

Following the PTO's drastic withdrawal action, Applicant discovered other reliable information suggesting the likelihood of outside interference with BlackLight's patent applications and breaches of the PTO' s duty to maintain the confidentiality of those applications. Applicant initially learned that Dr. Peter Zimmerman, former Chief Scientist for the State Department, had published an Abstract of an upcoming speech to the American Physical Society (APS)—a BlackLight competitor—boasting that his Department and the Patent Office "have fought back with success" against BlackLight. [See Attachment K, Tab C] In conversations with BlackLight's counsel, Dr. Zimmerman admitted that he had received information concerning BlackLight's applications through e-mails from Dr. Robert Park, spokesman for the APS, who told him of a contact in the PTO referred to by Dr. Park as "Deep Throat" with access to confidential patent information. [See Attachment K, Tab C]

An *APS News Online* bulletin, dated September 2002, suggests that Dr. Park is maintaining his questionable PTO contacts, apparently with the agency's blessing:

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[104] See Applicant's February 28, 2000 letter to Director Kepplinger documenting telephone and personal conversations between her and Applicant's counsel regarding improper outside influence that precipitated the withdrawal of BlackLight's five allowed applications. The PTO cited this letter in its March 22, 2000 Decision affirming its withdrawal action. [See Attachment G]

APS E-Board Passes Resolution on Perpetual Motion Machines

The APS Executive Board approved a resolution at its June 2002 meeting in Annapolis, MD, affirming the fraudulent nature of claims of perpetual motion machines.

The resolution was deemed necessary because of a recent increase in patent applications for such devices. Robert Park, APS Director of Public Information and author of the weekly electronic newsletter, "What's New," reported that the US Patent Office has received several patent applications for perpetual motion machines during the first six months of this year alone. [Park's 2000 book, *Voodoo Science*, devoted considerable space to the phenomenon of such devices throughout history.] The text of the APS resolution follows.

The Executive Board of the American Physical Society is concerned that in this period of unprecedented scientific advance, misguided or fraudulent claims of perpetual motion machines and other sources of unlimited free energy are proliferating. Such devices directly violate the most fundamental laws of nature, laws that have guided the scientific progress that is transforming our world.

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[Attachment Q (emphasis added)] Dr. Park's knowledge of the number of pending patent applications filed in the PTO directed to a particular subject matter—information that is supposedly kept confidential—raises additional questions as to his activities in interfering with the prosecution of U.S. patent applications.[105]

Of course, this should come as no surprise since Dr. Park has basically admitted his direct involvement in BlackLight's patent affairs, as evidenced by the September 6, 2002 issue of *What's New* he authored and published on the APS website:

> The status of BlackLight Power's intellectual property is fuzzier than ever. BLP was awarded Patent 6,024,935 for "Lower-Energy Hydrogen Methods and Structures," a process for getting hydrogen atoms into a "state below the ground

[105] Not coincidently, the Committee initially attacked the operability of Applicant's invention by mischaracterizing it as a "perpetual motion machine" and, therefore, *per se* unpatentable. The Committee quickly withdrew that line of attack after Applicant showed it was completely lacking in any merit.

> state". . . . You might expect these shrunken hydrogen atoms, called "hydrinos," to have a pretty special chemistry. Do they ever! Indeed, a second patent application titled "Hydride Compounds" had been assigned a number and BLP had paid the fee. Several other patents were in the works. That's when things started heading South. Prompted by an outside inquiry (who would do such a thing?), the patent director became concerned that this hydrino stuff required the orbital electron to behave "contrary to the known laws of physics and chemistry." The Hydride Compounds application [the '294 application] was withdrawn for further review and the other patent applications were rejected. [September 6, 2002 Online Newsletter of Dr. R. Park, *What's New* (Attachment C) (emphasis added)]

Dr. Park's startling admission was confirmed two weeks later in the September 20, 2002 issue of the *Online Newsletter* published by the James Randi Educational Foundation (JREF). In it, James Randi gleefully boasted about Dr. Park's contacting the Patent Office with the express purpose of sabotaging Applicant's patent rights:

> But why, hard on the heels of re-examining other questionable patents (see three weeks ago on this page), would the Patent Office have happened upon this particular one [BlackLight's withdrawn '294 application], when there are so many in this category? The secret can be inferred from Bob Park's weekly column, where we find: "Prompted by an outside inquiry (who would do such a thing?) . . ." That rascal!
>
> The very fact that the Patent Office has paid heed to the complaints that Park, the JREF, and others have made, speaks well for rationality. Let's hope that we can look forward to many quack devices and systems being re-evaluated. Let's see a lot more of this "extraordinary action" from the Director. As for BlackLight Power, says Park, "Their long-awaited IPO may have to wait a little longer." [September 20, 2002 Online Newsletter of the JREF, *Swift* (Attachment C) (emphasis added)]

Despite all of this overwhelming incriminating evidence of improper outside interference by competitors with an administrative patent proceeding—a possible criminal offense—the PTO continues to ignore this matter.

Apparently, this is not the first time that Dr. Park, James Randi and PTO officials have been embroiled in a patent controversy such as this one involving improper interference with a patent proceeding. Less than a year before Applicant's five allowed applications were withdrawn from issue in February 2000, the PTO was caught up in another scandal of sorts involving the issuance of U.S. Patent Nos. 5,748,088 and 6,011,476, granted on a device that can identify the obscured location of living entities.

Following issuance of the '088 patent, Dr. Park published in his *What's New* newsletter inaccurate, disparaging remarks, which were picked up by James Randi on his JREF website, concerning the operation and reliability of the claimed invention. [See Attachment H] An article published in *Science Magazine* during the pendency of the '476 patent also reported on the controversy and the involvement of Sandia National Labs (SNL) in the testing of the device. [Attachment D]

SNL's involvement and the disclosure of confidential information to David Voss, the author of the *Science* article, was itself the subject of some controversy and resulted in the issuance of an internal PTO memorandum that was placed in the '476 patent file. In that memorandum, the PTO felt compelled to reiterate its policy forbidding PTO employees from making public disclosures concerning pending patent applications:

PTO MEMORANDUM FOR ALL EMPLOYEES: MEDIA CONTACT POLICY

Posted Date: 06/25/99
Removal Date: 07/06/99

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
ASSISTANT SECRETARY AND COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

June 22, 1999

99-42

MEMORANDUM FOR All Employees

FROM: Acting Assistant Secretary of Commerce and Acting Commissioner of Patents and Trademarks

SUBJECT: Media Contact Policy

Since a memorandum on this subject was first issued several years ago, thousands of new employees have joined the PTO. Therefore, it is a good time to reiterate PTO policy concerning employee contact with members of the media including, but not limited to, those in print, broadcast, cable, and online publications.

> All requests, including telephone and e-mail, from members of the media for interviews, tours, and appearances should be directed to the Office of Public Affairs (Richard Maulsby or Brigid Quinn). Public Affairs will then determine the appropriate Office response for such requests and arrange for all interviews and any other meetings with the media. A member of the Public Affairs staff may attend interviews and meetings.
>
> This policy applies only to contact with the media, not to interactions with customers. Any questions about media contact should be directed to the Office of Public Affairs at 305-8341.
>
> Additionally, MPEP section 1701 and TMEP section 1801 specify that Office personnel should not comment on the validity or enforceability of any U.S. patent or trademark registration. These sections also caution employees about answering other particular inquiries concerning U.S. patents or trademark registrations. Any questions on this policy should be directed to your supervisor or to the MPEP Editor at 305-8813 for patents or to the Office of the Assistant Commissioner for Trademarks at 308-8900. [Attachment E]

Curiously, SNL is where Dr. Park previously served as head of its Surface Physics Division, leading Applicant to wonder whether SNL, or any of its sister labs, have had any similar involvement in the examination of this and other BlackLight applications. Applicant's curiosity on this point is further heightened by the fact that Examiner Bernard Souw, a former employee with Brookhaven National Labs, is a premier member of the Secret Committee who has been engaged in the examination of BlackLight's patent applications for some time now. [See, e.g., App'n Ser. No. 09/513,768] As discussed below, Examiner Souw's activities as lead scientist for a company he owns in competition with BlackLight, while simultaneously examining BlackLight's patent applications, raises a genuine conflict of interest, thus adding further cause for concern over outside interference with Applicant's patent rights.

If, as Applicant suspects, the PTO has conferred with others having ties to the APS, like Dr. Park or Dr. Zimmerman, or to other BlackLight competitors in withdrawing or rejecting BlackLight's applications, that information would be highly relevant and thus must be disclosed. Obviously, knowing the identity and potential biases of all persons providing input or otherwise involved in rejecting BlackLight's applications, especially those with competing interests, bears directly on the credibility of those rejections. This

point could not have been made more clear than the Committee's adoption of Examiner Souw's biased views in formulating its rejections in this case.

Applicant has, on numerous occasions, disclosed to PTO officials information relating to Dr. Park's undermining of BlackLight's patent rights, as relayed in Dr. Brewer's December 21, 2001 letter to then PTO Director Rogan, only to be ignored. [Attachment A. See also, for example, January 19, 2001 Letter to Director Kepplinger (Attachment K)] As Dr. Brewer explained in his letter, BlackLight is obviously concerned, among other things, that the PTO may have once again breached its duty to maintain confidentiality of U.S. patent applications under 35 U.S.C. § 122, 18 U.S.C. § 2071, 37 C.F.R. § 1.14, and M.P.E.P. § 101. The PTO's curt statement that it is "not in a position to discuss the issue at the present time" does little to allay those concerns.

Dr. Brewer further expressed in his letter distress over the suspected compromise of Applicant's patent rights to his novel hydrogen chemistry by a group of physicists with a vested interest in maintaining federal funding for projects based on a competing scientific theory and concern that those physicists continue to exert improper influence over the prosecution of BlackLight's pending applications. Those suspicions are only fueled by continued PTO silence on these issues while it undercuts Applicant's patent rights based on statements of competitors like Dr. Park. For instance, in the March 22, 2000 Decision justifying its withdrawal of Applicant's allowed patent applications, the PTO relied, in part, on a *Washington Post* article written by Dr. Park only slightly more than a month prior to the withdrawal:

> While petitioner in the accompanying letter points to favorable testimonials from scientists and entrepreneurs regarding the "revolutionary technology" that the instant application is asserted to embody, this does not establish that either the Director, Technology Center 1700, or the Director, Special Programs Law Office, committed reversible error, nor that the Notice should be withdrawn. In contrast, mainstream newspapers have reported this same "revolutionary technology" is accompanied by controversy in the scientific community. See Baard et al., Scientists and entrepreneurs have lots of ideas about new sources of energy; some may even be practical, Wall St. J., Sept. 13, 1999, at R16; **Park, Perpetual motion; still going around, Washington Post, Jan. 12, 2000, at H3.** [March 22 Decision at 7 (Attachment G)]

Applicant is naturally skeptical that this timing was simply a coincidence. Regardless, the mere fact that the PTO would rely on any competitor to "bad-mouth" BlackLight's technology is troubling. That it relied on Dr. Park of all people, known for conducting "hatchet jobs" on new technologies that threaten federal funding for the physicists he represents, is contemptible.

The same *Washington Post* that ran Dr. Park's libelous article rebuked its less than credible author in a subsequent article confirming his reputation for engaging in what it described a "search-and-destroy mission" against inventors and scientists who seek to advance the bounds of science. [See Article dated June 25, 2000 (Attachment M)] To quote the article's exact words, "Park's anger permeates his rebuttals, which border on character assassination." Noting that "thoroughness is not Park's strong suit," the article goes on to suggest that his intentions may be less than honorable:

> Park's failure to gather first-hand data is unfortunate, but his selective omissions are far more serious. In at least one case, he violated basic principles of journalism and science itself by apparently suppressing information that conflicts with his foregone conclusion. . . . Such tactics are reminiscent of the behavior of a zealous DA who is so convinced that a suspect is guilty that he feels entitled to withhold some information from the jury.

Dr. Park's competitive motives in attacking BlackLight's novel hydrogen chemistry, and thereby undermining its patent rights, are clear, as further recognized by the *Post* article in its description of Dr. Park as "a Washington lobbyist and PR flack for the American Physical Society." The article goes on to warn of the serious effects a rush to judgment can have without first-hand review of experimental evidence:

> This is a serious matter, since even poorly documented vitriol can jeopardize a scientist's reputation and future funding if it is disseminated with the complicity of a respected organization such as the American Physical Society.

Incredibly, in rationalizing its withdrawal action, the PTO pays tribute to a "hatchet man" like Dr. Park, who represents a competitor intent on sabotaging BlackLight's patent rights, by citing his hostile statements against BlackLight. Yet, in explaining the issuance of BlackLight's '935 patent, the PTO publicly denigrates its

entire examining corps, previously known for their careful study of experimental evidence in deciding whether to issue U.S. patents:

> [P]atent examiners do review [patent applications]. Unfortunately, patent examiners are swamped and sometimes things slip through. [Statement of Associate Solicitor Baer in *BlackLight Power, Inc. v. Q. Todd Dickinson*, May 22, 2000 Tr. at 7 (Attachment K, Tab A)]
>
> [E]xaminers are under tremendous pressure to produce work, and if they're going to approve [an application], they just approve it and kind of let it out the door. [May 22, 2000 Tr. at 48 (Attachment K, Tab A)]

As Dr. Brewer pointed out in his December 21, 2001 letter to Director Rogan, the PTO's outrageous public statements violate 35 U.S.C. § 282, under which statute all issued U.S. patents are presumed to be valid:

> **Presumption of validity; defenses**
>
> A patent shall be presumed valid. Each claim of a patent (whether in independent, dependent, or multiple dependent form) shall be presumed valid independently of the validity of other claims; dependent or multiple dependent claims shall be presumed valid even though dependent upon an invalid claim. The burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting such invalidity.

Underlying this fifty-year-old statutory presumption of validity is the premise of administrative regularity, which presumes that well-trained examiners with expertise in their respective fields properly carry out their examination duties by issuing only valid patents. See, e.g., American Hoist & Derrick Co. v. Sowa & Sons, Inc., 725 F.2d 1350, 1359 (Fed. Cir. 1984). This presumption was, in fact, confirmed by the capable work of Examiners Langel and Kalafut who, with over 50 years of experience between them, examined and allowed Applicant's '935 patent, along with BlackLight's withdrawn applications.[106]

As succinctly stated in Dr. Brewer's letter, Solicitor Baer's statements on behalf of the PTO should be alarming to just about everyone, with the possible exception of accused patent infringers, and most certainly do not reflect well on an agency charged

[106] The Examiners initially rejected all claims in these cases, but after conducting five lengthy personal interviews with Applicant and carefully considering Applicant's experimental evidence, they ultimately allowed those claims.

with maintaining the integrity of the patent system. Applicant felt that a meeting with Director Rogan to secure a retraction of those statements would be mutually beneficial to both sides. Yet once again, inexplicably, the PTO was not, and presumably is still not, prepared to discuss this issue.

These and other unfair assaults on Applicant's patent rights leave him to ponder: What would motivate the PTO to conduct itself with such total disregard for U.S. patent laws and regulations governing its administrative authority just to attack this one Applicant?

Applicant's fear is that these attacks may be attributable to competitors, like Dr. Park, who are coordinating an organized smear campaign to discredit BlackLight's technology. That fear is only heightened by the PTO's hiding behind strained theoretical arguments as an excuse for refusing to fairly evaluate Applicant's experimental evidence, while using its Secret Committee to issue anonymous rejections in this and other BlackLight applications. Dr. Brewer also brought these issues to Director Rogan's attention as an agenda item for a meeting that, unfortunately, has never taken place.

Applicant has a right to know the identity and qualifications of all persons providing input to, or otherwise participating in, the examination process. This information bears directly on the credibility of the rejections that have been entered in this and other BlackLight applications. For instance, if Dr. Park or any of his physicist cronies have been consulted in denying Applicant his patent rights, it would certainly explain the arbitrary and capricious handling of the experimental evidence of record in those cases.

Particularly germane is the identity of <u>all</u> persons responsible for, or otherwise involved in, creating the Office Actions, Attachments, and Appendices that make up the record in this application and other BlackLight cases. To this day, the Committee has refused, without any adequate explanation, to provide this vital information to the detriment of Applicant.

Furthermore, Applicant is entitled to know which PTO officials are ultimately responsible for analyzing Applicant's scientific data evidencing the existence of lower-energy hydrogen, and which officials have the final authority to decide the fate of

BlackLight's applications. The Committee's unfair refusal to divulge that information has also seriously handicapped Applicant's ability to effectively respond to and overcome the rejections of record.

For instance, Applicant has been stymied on numerous occasions in attempts to discover the basis for various positions articulated by the Committee, or the status of certain actions it has taken. Seldom are the Examiners of record, who are mere signatories to the Committee's handiwork, or their immediate supervisors, able to give any useful guidance on those subjects, either because they have no authority to do so and cannot divulge who does or, in some cases, they do not know who even has custody of the patent file so as to investigate the answer to a particular question.

Knowing who is responsible for analyzing the record evidence would also allow Applicant to assess that person's qualifications, as compared to those Ph.D. scientists who have peer reviewed the published experimental evidence confirming lower energy states of hydrogen. Equally important, by knowing who has authority to issue BlackLight's applications, Applicant can more easily ascertain and satisfy the patentability standards being applied in rejecting claims to his novel hydrogen technology.

Illustrating this last point, Applicant attempted to force the Secret Committee to set reasonable standards by which his data could be accepted as reliable proof by requesting the personal Interview that was held on February 21, 2001. Of course, to effectively determine the standards being applied against Applicant, he first had to identify the person(s) responsible for setting those standards.

Applicant, however, was only partially successful in that effort. Prior to the February 21 Interview, Applicant's counsel uncovered the identity of only one Committee member, Examiner Vasu Jagannathan, who played a role in rejecting BlackLight's applications. Incredibly, Examiner Jagannathan initially denied any such involvement, accurately noting that his name did not appear anywhere in the record. He therefore refused counsel's explicit request that he attend the upcoming Interview. Only after counsel wrote to a high-level supervisor demanding that Examiner Jagannathan attend did counsel receive confirmation that the Examiner was "directly involved in the creation of the Office Action" to be discussed at the Interview and that he would indeed

attend. [See January 19, 2001 letter to Director Esther Kepplinger (Attachment K) and February 12, 2001 Letter from Director Jacqueline M. Stone (Attachment N)]

Examiner Jagannathan confirmed his direct involvement by leading the Interview discussions. The Examiner's participation afforded Applicant an opportunity to assess his qualifications to examine and evaluate the experimental evidence of record. Applicant was astonished to hear Examiner Jagannathan basically admit he was unqualified to do so based on several of his comments. One of those comments, as discussed previously, included his characterization of Applicant's highly reliable spectroscopic data confirming lower energy states of hydrogen as a "bunch of squiggly lines."

When pressed for guidance on what standards he used to evaluate Applicant's scientific data and to decide whether to issue his patents, Examiner Jagannathan would not elaborate. Rather, he proposed a new standard requiring Applicant to submit and publish his data in peer-reviewed journal articles before he would give it serious consideration. Despite strenuous objections to this newly minted standard requiring public disclosure of confidential information, Applicant has nonetheless worked diligently to comply with it.

Over the subsequent years, Applicant has used vast resources to present experimental evidence of lower energy states of hydrogen—much of it generated by independent third parties—in over 60 peer-reviewed articles published in the prestigious scientific journals mentioned above. Despite this significant accomplishment, the Committee, true to form, has essentially ignored that published evidence.

Even more impressive, Applicant has successfully met the Committee's new "publication" standard despite attempts by another of Applicant's main detractors, Dr. Zimmerman, to undermine that effort. [See Attachment H] Applicant's discovery that Dr. Zimmerman has been contacting various journals to dissuade them from publishing Applicant's articles is especially alarming given that the Committee has relied on <u>non</u>-peer reviewed statements by him—statements that were posted to an internet bulletin board of all places and that he readily admits are biased—to reject BlackLight's applications.

If, as Applicant suspects, the Committee has cooperated with Dr. Zimmerman, or other such biased individuals, in denying Applicant his patent rights, while those same individuals have worked behind the scenes to undermine Applicant's compliance with the Committee's concocted publication requirement, then again, that information is highly relevant and should be disclosed without further delay. Such a scenario would be entirely consistent with the prior admission by Dr. Zimmerman that while he served as Chief Scientist for the State Department, his Department and the PTO "fought back with success" against BlackLight. [See Attachment K, Tab C.]

Applicant is hardly surprised by his inability to break the PTO's code of silence on the suspicious handling of BlackLight's applications given that the PTO is also stonewalling similar inquiries from five U.S. Senators—four of whom requested that Senator Patrick Leahy, Chairman of the Judiciary Committee overseeing the PTO, and/or Commerce Secretary Donald Evans, look into this matter. [See letters to and from Senators Max Cleland, Robert Torricelli, Jon Corzine, Ron Wyden, and Gordon Smith (Attachment O)] The PTO's continued refusal to cooperate in response to Senate inquiries suggests that, perhaps, it has something to hide.[107]

If the PTO looks to the Federal Circuit's June 28, 2002 Decision for license to continue its unfair and dilatory prosecution through secret examination, it will not find it. Indeed, Judge Newman, in rationalizing her ruling, incorrectly assumed that the PTO would fairly and expeditiously prosecute BlackLight's applications:

> Such action must of course be reasonable under the circumstances and rare in occurrence, lest the emergency become the rule. But when necessary in order to fulfill the PTO's mission, <u>with safeguards to the interests of the applicant including fair and expeditious further examination</u>, we agree with the district court that the action taken is a permissible implementation of the statute and regulation. [See *BlackLight Power* at pages 1537 (Attachment B) (emphasis added).]

[107] In the PTO's reply to the Senators' inquiry letters, Robert L. Stoll, Administrator for External Affairs, contended that any comments in response to those inquiries would be "inappropriate" because of the then-pending appeal to the Federal Circuit in *BlackLight Power Inc. v. Dickinson*, Civ. No. 00-0422 (D.D.C). [See Attachment O] Putting aside the fact that the issues then on appeal had absolutely nothing to do with the points of inquiry, this contrived excuse has gone stale as the Federal Circuit decided that case many years ago in June 2002. [See Attachment B] By its own statements, nothing now prevents the PTO from cooperating with the U.S. Senate regarding the administrative irregularities brought to its attention.

Nothing could be further from the truth. As documented by Applicant, the PTO's prosecution of BlackLight's applications has been nothing short of hostile and its attempt to hide the mistreatment of Applicant behind the authority of a Secret Committee only exacerbates the unfairness of those actions. Because this untenable situation has failed to provide the safeguards to the interests of Applicant, including the fair and expeditious further examination contemplated by the Federal Circuit in its Decision, Applicant has herein requested an equitable remedy that the PTO immediately issue all five of the withdrawn BlackLight applications that gave rise to that Decision. [See Demand for Information and Redress, *infra*.]

Applicant strongly urges the PTO to break its silence and to engage in an open and honest discussion of these issues that continue to plague the examination of BlackLight's pending applications. To this end, Applicant renews his earlier commitment, as expressed in Dr. Brewer's December 21, 2001 letter, to meet with the PTO Director and/or any other government officials, anywhere, anytime, to resolve these outstanding issues. Applicant sincerely hopes that the Director will likewise commit himself to achieving the same objective so that a fair and expeditious prosecution of all of BlackLight's applications that safeguards Applicant's interests, as envisioned by the Federal Circuit, can be achieved with mutually beneficial results.

Part of that forward movement should include a complete and proper consideration of Applicant's overwhelming experimental evidence confirming the utility and enablement of Applicant's novel hydrogen technology. In view of that evidence, Applicant submits that the rejections under 35 U.S.C. §§ 101 and 112 are misplaced and should be withdrawn, and that the present application is in condition for allowance.

Discussions Held And Agreements Reached
During The February 11, 2003 Interview

The above-mentioned problems associated with the Secret Committee's examination of this and other BlackLight applications can be summarized as follows based on its failure to:

(1) identify all persons from within and outside the Patent Office who contributed to, or were otherwise involved in, withdrawing or rejecting BlackLight's applications;

(2) identify those persons having ultimate authority to analyze the vast body of experimental evidence demonstrating the existence of lower energy states of hydrogen and, based on that analysis, for deciding whether to issue patents on Applicant's novel hydrogen technology;

(3) establish and apply consistent patentability standards and guidelines by which that patentability decision is to be made; and

(4) properly analyze the evidence of record—now published, or to be published, in over 60 peer-reviewed journal articles—that the Committee required Applicant to submit.

The Committee merely perpetuated those failures in its previous Office Actions by dismissing, without serious analysis, Applicant's submitted data evidencing lower energy states of hydrogen. Frustrated by the Committee's inaction, but still determined to get a fair and expeditious hearing, Applicant requested and received the courtesy of another personal Interview, held February 11, 2003, to present his evidence and to discern the standards by which the ultimate decision-maker would be evaluating it.[108]

To that end, Applicant repeatedly requested that Examiner Jagannathan attend the Interview, since he had led the prior Interview held February 21, 2001, and, despite attempts to keep his identity secret, he was the only person known at the time to have been directly involved in creating the substantive Office Actions of record. Specifically, Applicant sought to question Examiner Jagannathan on why he still refused to accept Applicant's scientific data evidencing lower-energy hydrogen after it had been published, or was soon to be published, in what was then over 40 (now over 50) peer-reviewed journal articles, which he himself had required. Applicant, however, never got the chance to pose that question. Without explanation, Examiner Jagannathan refused

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[108] Although the Interview Summary does not specifically list the serial number of all BlackLight applications as being the subject of the February 11, 2003 Interview, Examiners Langel and Kalafut agreed beforehand that the Interview would be held to address the similar rejection of claims in all assigned BlackLight cases based on an alleged lack of utility and inoperability.

to attend the Interview, just as he had refused to attend the Interview held two years earlier—only this time, he did not show up.

Applicant also requested that Examiners Wayne Langel and Stephen Kalafut attend the Interview, since they had previously allowed the five BlackLight applications that were mysteriously withdrawn from issue and their names were the only ones appearing in the record as signers of the substantive Office Actions under consideration. Examiners Langel and Kalafut did appear for the Interview, together with their immediate supervisors, SPE's Patrick Ryan and Stanley Silverman. Examiner William Wayner, who was assigned to one BlackLight application prior to his retirement from the PTO and who expressed an interest in attending the Interview, also appeared.

Also attending the Interview and leading the discussions on the PTO's behalf was Quality Assurance Specialist Douglas McGinty, who until that time had never been identified to Applicant as having played any role in the examination of his applications.

Attending the Interview on behalf of BlackLight Power were the inventor, Dr. Randell L. Mills, his counsel, Jeffrey S. Melcher and Jeffrey A. Simenauer, and company Director Dr. Shelby Brewer.

Also attending the Interview as an observer at Applicant's request was Ted C. Liu, Senior Legislative Assistant for Congressman David Wu, who represents the 1st District of Oregon.

During the Interview, Applicant made a sincere effort to advance the prosecution of his applications and to find common ground upon which all of these cases, once again, would be allowed to issue as patents. Applicant believed it was a worthwhile effort in light of Examiner Langel's statements on the record reaffirming his consistent view that Applicant's novel hydrogen technology is fully operable and, therefore, entitled to patent protection. The Interview was also significant in view of the following representations and agreements that resulted from the discussions between Applicant and lead-Specialist McGinty:

(1) Applicant will identify the scientific data supporting lower energy states of hydrogen generated and furnished by independent third parties;

(2) the Examiners whose signatures appear on the rejections of record, *i.e.*, Examiners Langel, Kalafut, and Wayner, have full authority to review that data and, based on their review, to issue patents as deemed appropriate; and

(3) Applicant will confer with the signatory Examiners, either by telephone or in person, to review each assigned application on a claim-by-claim basis to ensure that the scientific data presented adequately supports the scope of the claims. For those claims determined to be adequately supported by the data, a patent will issue. For any claims deemed to be inadequately supported, Applicant reserves the right to continue seeking that broader claim coverage in subsequent proceedings.

Applicant appreciated the guidance Specialist McGinty provided during the Interview for securing BlackLight's patents. Based on that guidance, Applicant presented comments in two pending applications for which Responses were due detailing the substance of discussions held at the Patent Office on February 11th and identifying the independent, third-party data per agreement (1) above, which information is reproduced below. [U.S. Serial Nos. 09/110,678 and 09/362,693]

Applicant's comments confirmed Examiner Langel's long-held view that the claims in those cases were in condition for allowance. Applicant therefore requested that Examiner Langel exercise his authority to issue a Notice to that effect per agreement (2) above so that patents could then be issued.

Following up on the Responses filed in those pending applications per agreement (3) above, Applicant arranged for an Interview with Examiner Langel to review the cases on a claim-by-claim basis to ensure that the scientific data presented adequately supported the scope of the claims in those cases. In fact, Applicant and Examiner Langel reached a tentative understanding that certain claims were adequately supported by the data and that Applicant was therefore entitled to his patents.

Unfortunately for Applicant, that understanding was short lived after Examiner Langel, "for moral and ethical reasons," agreed under the most grievous of circumstances to his removal from examining all BlackLight applications to which he was assigned. Applicant was dismayed to further learn from Examiner Langel that

the PTO has adopted an "allowance is not an option" policy with respect to all pending BlackLight applications. Before discussing the prejudicial ramifications of these unfortunate incidents, however, Applicant presents the following recap of the discussions held during the February 11, 2003 Interview that lead to the above agreements.[109]

Just prior to the Interview, Specialist McGinty asked that Mr. Liu speak by telephone with Talis Dzenitis, a Congressional Affairs Specialist in the PTO's Legislative and International Affairs Office, to discuss his reasons for attending. Mr. Liu explained to Specialist Dzenitis that a constituent associated with BlackLight had contacted Congressman David Wu complaining of the irregular procedures the PTO has used in examining the company's pending patent applications. The procedures complained of included the PTO's withdrawal of the five applications approved by Examiners Langel and Kalafut for issuance as patents and the subsequent rejection of those and other BlackLight applications by an unknown group of PTO officials referred to by Applicant as a "Secret Committee."

Specialist Dzenitis represented to Mr. Liu that no such secret committee existed at the Patent Office. Applicant was surprised by that representation considering that a group of anonymous PTO officials were known to be handling BlackLight's applications and drafting the substantive Office Actions that the Examiners of record were instructed to sign.

Examiner Langel confirmed as much in an extended discussion he had with Mr. Liu and Applicant's counsel following the formal phase of the Interview. During that discussion, Examiner Langel repeated his prior denials of having authored the substantive Office Actions of record in the BlackLight applications to which he was assigned, even though those Actions bear his signature. Examiner Langel also repeated his previously expressed views that Applicant is entitled to patents on his novel hydrogen technology and that he wanted to issue those patents. Examiner Langel explained, however, that other PTO officials unknown to him having higher

[109] Much of the substance of these discussions was confirmed in e-mail correspondence between Mr. Liu and Applicant's Counsel. [See Attachment P]

authority were responsible for drafting the substantive Office Actions he signed and for deciding whether to issue Applicant his patents.

The only person Examiner Langel could identify for Mr. Liu as "having something to do with the Office Actions" was Examiner Jagannathan, whose name does not appear on any Office Action. As noted above, Examiner Jagannathan kept his identity a secret from Applicant until counsel exposed his direct involvement in creating the Office Actions of record and forced him to attend the prior Interview that he led on February 21, 2001. [See January 19, 2001 letter to Director Esther Kepplinger (Attachment K) and February 12, 2001 Letter from Director Jacqueline M. Stone (Attachment N)] When the recent February 11, 2003 Interview started, it was Specialist McGinty, another previously unidentified PTO official, who led the discussion.

Following the telephone conversation with Specialist Dzenitis, in which he denied the existence of a secret committee, Mr. Liu joined the Interview already in progress. Applicant began the Interview with a general discussion of his novel hydrogen technology and a presentation of the experimental evidence confirming its operation and utility. Specifically, Applicant explained to the PTO officials in attendance how independent laboratory studies, including those conducted by a leading Los Alamos researcher and by a NASA funded group, as well as other highly reliable scientific data, demonstrate the existence of lower energy states of hydrogen underlying his technology.

At no time during Applicant's presentation did the PTO officials analyze or otherwise address to any significant degree the merits of that data proving the existence of lower-energy hydrogen. Rather, these officials—with the exception of Examiner Langel—raised non-technical arguments, similar to those raised in the pending Office Actions, why lower-energy hydrogen could not exist and, thus, why they were justified in according the real-world data little or no weight.

The first such argument, raised by Examiner Wayner, was based on unrelated technologies that have been subjected to ridicule in the scientific community, such as perpetual motion, cold fusion, and 100-miles-per-gallon carburetors. Examiner Wayner compared those controversial technologies to BlackLight's novel hydrogen chemistry and then asked Applicant: "How is your invention any different?"

Applicant pointed out significant differences. Unlike the far-fetched inventions mentioned by Examiner Wayner, Applicant explained that his inventions have been actually reduced to practice, as demonstrated by the many working prototype energy cells developed over the past ten years and the novel chemical compounds produced by the process, which were made available to the PTO in the past and again during the Interview. In fact, Applicant invited the PTO officials to visit his laboratory in Cranbury, New Jersey and witness the operation of his energy cells for themselves, but like prior invitations, this one too was ignored.

Applicant further distinguished his claimed inventions based on the substantial body of experimental evidence that corroborates the existence of lower energy states of hydrogen. Again, none of the PTO officials who raised non-technical arguments questioning the operability of Applicant's novel hydrogen technology made any real attempt to analyze that corroborating evidence. Indeed, Examiner Wayner frankly admitted that his background was in mechanical engineering and, therefore, he was not qualified to conduct such an analysis.

Examiner Wayner also questioned why, if BlackLight's technology was such an important discovery, the company had not yet developed a commercial device for producing energy. Applicant explained that the high cost of developing commercial products was an impediment and that, because BlackLight was not positioned to handle commercial development, it was looking to license patents on its technology to other companies for commercialization purposes.

Concerned that Examiner Wayner might be introducing yet another new patentability standard, requiring the sale of a commercial product, counsel pressed the Examiner on whether that was his intention. Examiner Wayner plainly stated it was not and, in response to a specific question from Mr. Liu, affirmed that Applicant need not prove commercial applicability to secure a patent for his invention.[110]

Applicant also became alarmed when Examiner Wayner, in referring generally to BlackLight's "detractors," invoked only the name of APS lobbyist and spokesman Dr.

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[110] Despite these assurances, Applicant is proceeding under the assumption that the PTO <u>is</u> requiring proof of commercial applicability, especially in light of his discovery that the Committee now takes the position that "allowance is not an option" in BlackLight's cases. [See *infra.*]

Robert Park as someone who disputes the existence of lower energy states of hydrogen.[111] Applicant's counsel wanted to raise issues relating to Dr. Park's "Deep Throat" contact in the Patent Office and his reputation for conducting "hatchet jobs" on new technologies that threaten his lobbying of hundreds of millions of dollars on behalf of the APS to federally fund its pet projects. [See *supra*.] Specialist McGinty, however, cut counsel off, refusing to discuss the matter. When Specialist McGinty suggested that BlackLight has a "similar agenda," noting its recent NASA contract, Applicant corrected him, explaining that BlackLight does not receive any government funding for its research. Specialist McGinty had no response and the discussion moved onto other, less controversial subjects.

Examiner Wayner raised other issues regarding the reliability of the scientific evidence presented by Applicant. That evidence included spectroscopic data, which counsel described as being equivalent to a "chemical fingerprint." Counsel further noted that Dr. Park himself, whom Examiner Wayner identified as BlackLight's chief antagonist, has proclaimed the extraordinary reliability of spectroscopic data. [See *supra*.]

Yet when Applicant tried to present this highly reliable spectroscopic data at the Interview showing the spectral lines corresponding to lower-energy hydrogen, *i.e.*, a "hydrino" state, Examiner Wayner interrupted, commenting that "spectroscopic lines are meaningless" and "don't mean a hill of beans" to him. That comment was reminiscent of a previous one by Examiner Jagannathan characterizing Applicant's spectroscopic data as "a bunch of squiggly lines." [See *supra*.]

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[111] To Applicant's astonishment, in the Office Actions issued in Examiner Wayner's one assigned case, the Committee has continued to cite Dr. Park's biased statements against Applicant as a basis for rejecting claims in this case:

> The opinion of Robert Park set forth in the Examiner's acton of 4/14/00, paper #16. i.e. "But according to the country's leading organization of academic physicists, Mills' hydrino theory has no credibility. "There is virtually nothing that science does not know about the hydrogen atom," said Robert Park, director of the Washingtong [sic] office of the American Physical Society. "The ground state is defined as the (energy) state below which you cannot go ... the thought there is some state below the ground state is kind of humerous [sic]." [See 4/26/04 Office Action at p. 4 in U.S. App'n Ser. No. 09/181,180.]

Counsel again became concerned that BlackLight's applications were being evaluated using rather loose patentability standards. Counsel therefore requested that the PTO officials provide some guidance regarding the evidentiary requirements they were imposing on Applicant. Specialist McGinty and Examiner Wayner at first did not respond directly to Counsel's request for guidance, but rather began questioning the accuracy of the test data Applicant submitted to confirm the existence of lower energy hydrogen.

Applicant explained that the submitted test data was generated by highly qualified Ph.D. scientists, many of whom represent independent laboratories. Applicant further noted how this data had been extensively peer-reviewed in the 40-plus (now over 50) articles published, or soon to be published, in prestigious scientific journals, including the *Journal of Applied Physics*. Applicant also provided Specialist McGinty—much to his surprise—with specific data showing the lower-energy state spectral lines that were published in the prestigious spectroscopic publication, *Journal of Molecular Structure*.

Applicant was astounded by the refusal of Specialist McGinty and Examiner Wayner to accept the reliability of the scientific data appearing in these published journal articles, especially considering the PTO's routine acceptance of evidence submitted in printed publications to overcome utility rejections. See, *e.g.*, MPEP § 2107.01 (VI) pp. 2100-33 ("An applicant can [submit evidence in response to a utility rejection] using any combination of the following: amendments to the claims, arguments or reasoning, or new evidence submitted in an affidavit or declaration under 37 CFR 1.132, or in **a printed publication**." (emphasis added)).

Counsel also reminded the PTO officials of the standard imposed by lead-Examiner Jagannathan during the previous Interview held February 21, 2001 that conditioned his consideration of evidence of lower-energy hydrogen on its publication in peer-reviewed journal articles based on the reliability of the peer-review process. Counsel then noted once again that, despite Examiner Jagannathan's failure to provide legal authority for imposing this unreasonable standard, Applicant had not only met it, but had exceeded it with over 40 (now over 50) journal articles. Having done so, counsel expressed extreme frustration with the PTO's continued refusal to seriously

analyze the published scientific data based on manufactured excuses, such as this newly concocted one concerning the accuracy of Applicant's data.

Specialist McGinty raised yet another weak excuse for ignoring the published data by asking what assurances Applicant could provide that the journal articles had been actually peer reviewed! Mystified by that question, Applicant could only state what is a simple known fact: to get scientific data published in a journal article, it must first go through a rigorous peer-review process. Indeed, many of Applicant's articles went through numerous drafts and required further experimentation as directed by the Ph.D. scientists who peer reviewed those articles.

At that point in the Interview, Specialist McGinty admitted that, like Examiner Wayner, he was not qualified to analyze the published data. Applicant was surprised by that admission, since the Interview was being led by Specialist McGinty and had been arranged for the express purpose of presenting the experimental evidence of record.

Examiner McGinty's admission merely fueled Applicant's prior concerns that his published scientific data was not being properly considered, prompting counsel to ask who was responsible for analyzing that data. Specialist McGinty replied by stating that Examiners Langel and Kalafut, the Examiners of record, had that responsibility. That too came as a surprise since Examiners Langel and Kalafut were the ones who had originally reviewed Applicant's experimental evidence in allowing the five BlackLight applications that were subsequently withdrawn from issue. Applicant, however, was relieved to learn that these two Examiners, who had over 50 years of experience between them and who were obviously qualified to analyze the published data, were being reassigned that task.

Counsel then addressed the vexing problem of constantly changing patentability standards that had been plaguing the examination process. Counsel specifically mentioned, for example, the prior Office Actions that claimed Applicant's lower-energy hydrogen technology violated known laws of physics and chemistry without specifically identifying even one such law, and then required Applicant to prove otherwise.

Counsel also cited a recent Office Action dismissing Applicant's scientific data out of hand for failing to prove the invalidity of quantum theory:

> The request for reconsideration has been entered and considered but does not overcome the rejection . . . because there is no evidence presented which would prove applicant's contention that the theory of quantum mechanics is invalid." [October 7, 2002 Advisory Action entered in U.S. Serial No. 09/110,717]

When Specialist McGinty accused Applicant of putting a "spin" on the Examiner's rejection, counsel noted that he had been reading the above quotation directly from the Office Action.

Counsel also mentioned other recent Office Actions filed in BlackLight cases that dismissed Applicant's recent submission of peer-reviewed journal articles, in accordance with the standards imposed by Examiner Jagannathan, as being merely "cumulative" when it clearly was not and even the originally submitted evidence had not been properly analyzed.

Expressing frustration over the PTO's failure to provide any consistent patentability standards to guide Applicant, counsel once again requested that Specialist McGinty provide such guidance. Specialist McGinty again raised concern over the integrity of the experimental evidence, but indicated that he would be more receptive to that evidence if it was validated by independent third parties.[112]

Applicant explained to Specialist McGinty that much of the evidence submitted over the previous four years <u>was</u>, in fact, generated by independent third parties. Applicant then began citing examples of the extensive independent third-party evidence disclosed in publications previously cited to the PTO, as well as more recently generated evidence that was subsequently submitted.[113] Specialist McGinty did not

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[112] Just as Specialist McGinty sought assurances at the February 11 Interview that persons involved in generating and furnishing the scientific data submitted by Applicant are independent and unbiased, Applicant deserves similar assurances that those involved in rejecting BlackLight's applications are also independent and unbiased. Despite Applicant's repeated requests for such assurances, none have been given. The genuine conflicts of interest uncovered by Applicant involving Examiner Souw and his clearly biased views against BlackLight adopted by the Committee merely underscore the importance of this highly relevant information.

[113] See R. L. Mills, B. Dhandapani, M. Nansteel, J. He, A. Voigt, "Identification of Compounds Containing Novel Hydride Ions by Nuclear Magnetic Resonance Spectroscopy", Int. J. Hydrogen Energy, Vol. 26, No. 9, (2001), pp. 965-979.
R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "New Power Source from Fractional Quantum Energy Levels of Atomic Hydrogen that Surpasses Internal Combustion", J. Mol. Struct., Vol. 643, No. 1-3, (2002), pp. 43-54.

respond, whereupon counsel noted that the PTO's unfounded concern that the record evidence lacked third-party validation merely demonstrated its failure to thoroughly analyze that evidence.

Further demonstrating a lack of familiarity with the record evidence, Specialist McGinty criticized Applicant's experimental evidence as a whole by referring numerous times to only high-power plasma data. Applicant repeatedly pointed out that the plasma data was but a small fraction of the submitted evidence and that it was presented primarily to provide additional support for his plasma-related applications.

Applicant noted that the vast body of other scientific data he submitted relates to a broad range of analytical studies demonstrating the existence of lower energy states of hydrogen. For example, regarding those applications relating to novel chemical compounds, Applicant pointed Specialist McGinty to the extensive spectroscopic data supporting the identification of those compounds. Specialist McGinty, however, apparently did not understand the significance of that data, stating that the NMR data confirming lower-energy hydrogen could have been due to nitrogen. Applicant had to explain that, as a matter of basic scientific knowledge, NMR data only shows protons and that no other element but hydrogen is in the data range. Applicant also explained that the NMR data confirms the presence of an internal energy source.

Knowing that highly qualified Examiners Langel and Kalafut were once again responsible for analyzing the published data was reassuring. There still remained, however, one nagging issue, namely, who had the ultimate authority to issue Applicant his patents. Counsel expressed concern that the pending applications were being examined in secret and that, without knowing who had that authority, Applicant was being unfairly denied an opportunity to present his case to the actual decision-maker.

Specialist McGinty then stated in no uncertain terms that Examiners Langel, Kalafut, and Wayner, the signers of the Office Actions under consideration, had "full authority" to examine the pending applications and to issue the patents.

J. Phillips, R. L. Mills, X. Chen, "Water Bath Calorimetric Study of Excess Heat in 'Resonance Transfer' Plasmas", Journal of Applied Physics, submitted.

A. J. Marchese, P. M. Jansson, J. L. Schmalzel, "The BlackLight Rocket Engine", Phase I Final Report, NASA Institute for Advanced Concepts Phase I, May 1-November 30, 2002, http://www.niac.usra.edu/files/studies/final_report/pdf/752Marchese.pdf.

Upon hearing that statement, counsel immediately turned to Examiner Langel and asked him point blank whether, after having studied the experimental evidence of record, he still believed that BlackLight's patent applications were allowable. The Examiner replied in no uncertain terms, "Yes, they're still allowable."

Counsel then asked Examiner Langel whether he was prepared to immediately allow the claims and issue Applicant his patents in those applications assigned to him, as is customary during an Interview, to which the Examiner replied, "Fine with me."

Specialist McGinty, however, expressed uneasiness over Examiner Langel's agreement to allow claims at the Interview. Specifically, he stated his concern that even if Applicant's claimed technology were found to be operable, there were still issues of novelty and nonobviousness to be addressed before a patent could be issued.

Counsel was surprised by that statement given the PTO's arguments over the prior three years that Applicant's inventions were inoperable based on an incorrect assumption that lower-energy hydrogen cannot possibly exist. Counsel pointed out the obvious contradiction in arguing that the Examiners may still need to conduct a prior art search for possible disclosure of Applicant's lower-energy hydrogen technology.

Counsel further noted the PTO's own examination guidelines requiring Examiners to evaluate the operability and utility of a claimed invention together with its novelty and nonobviousness following a complete prior art search. See MPEP § 706.[114] Counsel again turned to Examiner Langel to confirm whether that was his understanding. The Examiner replied that it was and indicated that, in fact, the first thing he did was to conduct a thorough prior art search because he thought that might be the easiest way to dispose of the applications assigned to him. Examiner Langel

[114] MPEP § 706 provides in pertinent part:

> After the application has been read and the claimed invention understood, a prior art search for the claimed invention is made. With the results of the prior art search, including any references provided by the applicant, the patent application should be reviewed and analyzed in conjunction with the state of the prior art to determine whether the claims define a useful, novel, nonobvious, and enabled invention that has been clearly described in the specification. The goal of examination is to clearly articulate any rejection early in the prosecution process so that the applicant has the opportunity to provide evidence of patentability and otherwise reply completely at the earliest opportunity.

explained, however, that he was unable to reject the applications on prior art grounds, which was why he originally allowed them.

Counsel acknowledged Specialist McGinty's hesitance to issue Applicant patents covering his claims at the Interview and assured him that Applicant wanted to work with him to remove any lingering concerns. Counsel then specifically asked Specialist McGinty to articulate how they might proceed in trying to accomplish that mutually beneficial goal. In response, Specialist McGinty indicated that, in the next Response to any pending or subsequent Office Actions, Applicant should focus on identifying the scientific data generated by independent third-party testing, as opposed to test data generated solely by Applicant. Counsel agreed to do that.

Specialist McGinty further expressed concern over whether that scientific data, even if assumed to be reliable, was commensurate with the scope of the claims of the various applications to adequately support patentability. Counsel stated that Applicant's data did adequately support the claimed subject matter. Counsel, however, recommended reviewing the claims of each application one by one with the assigned Examiners to see if at least some agreement could be reached as to those claims that are adequately supported and for which patents can be issued. As for any remaining claims that the Examiners believe are not adequately supported by the scientific data, Applicant would be free to seek such broader claim coverage through continued prosecution.

Specialist McGinty agreed that this was a reasonable way to proceed and granted a request by counsel, Mr. Simenauer, that this agreement be memorialized in writing in an attachment to the Interview Summary Form. Mr. Simenauer offered to draft this agreement, as is common practice, and Specialist McGinty enthusiastically accepted the offer. Mr. Simenauer then drafted the following Attachment as Specialist McGinty looked on:

ATTACHMENT TO INTERVIEW SUMMARY FORM

Applicant requested that the following points discussed at the Interview held on February 11, 2003 be included as an Attachment to the Interview Summary Form.

> Applicant's counsel and the Examiners in attendance at the Interview agreed to meet again at a future date, either in person or by telephone, to continue discussions regarding the patentability of Applicant's pending patent applications. Specifically, the Examiners expressed concern that Applicant's experimental evidence be commensurate with the scope of the claims. To address that concern, Applicant's counsel agreed with the Examiners to go through the patent applications claim-by-claim with the Examiners and demonstrate how the scientific data supports those claims.
>
> For those claims that are supported by the data, the PTO agrees to issue those claims. For those claims that the PTO determines are not supported by the data, Applicant will continue to seek that broader claim coverage in subsequent proceedings. [Attachment F]

After completing the two-page handwritten Attachment, Mr. Simenauer read it out loud in the presence of Specialist McGinty and Examiner Langel so that they could confirm its accuracy and make any necessary changes. When asked by counsel whether they were satisfied with the wording of the Attachment, Specialist McGinty stated that he was, as did Examiner Langel, who then signed each of the two pages. There was absolutely no confusion as to the agreement to issue patents for those claims found to be supported by the scientific data.

Incredibly, in a transparent attempt to rewrite history, some unknown PTO official apparently instructed Examiner Langel to sign a subsequent communication mailed over <u>two weeks later</u>, on February 26, 2003, that included an attached "Supplement to Interview Summary" (Attachment F), which provides in pertinent part:

> The following is a supplement to the summary concerning the February 11, 2003 interview re 09/501,622, etc. . . . A two-page Interview Summary was provided by Examiner Langel. A two page "Attachment to Interview Summary Form" also was provided by Mr. Simenauer. While the Attachment may represent the applicant's understanding of the interview, two points must be clarified.
>
> First the second page of the applicant's attachment states in part: "for those claims that are supported by the data, the PTO agrees to issue those claims." The PTO made no such agreement. Instead, the PTO representatives indicated that the rejections under both 35 USC 101 and 112, 1st para., are outstanding and that evidence as to verification by credible, established, independent third parties would carry more persuasive weight.

Second, QAS Douglas McGinty was not listed in the Examiner's Interview Summary. He was present during the interview with the aforementioned attendees.

[signed] Wayne Langel
Primary Examiner
Art unit 1754

If PTO officials wanted to retract one of the key agreements reached at the Interview, they should have expressly said so, identifying who made the decision and giving reasons for the retraction. Since this was not done, Applicant has no choice but to rely on the accuracy of the contemporaneous written record.

Moreover, in view of other agreements reached at the Interview, the suggestion that there was no agreement to issue patents under the stated conditions is absurd—though hardly surprising given the sordid prosecution history of BlackLight's patent applications. Specialist McGinty plainly stated on the record that the Examiners who signed the outstanding rejections have full authority to review the data and to issue Applicant his patents. Also of record is Examiner Langel's unequivocal statement that, based on his review, he was prepared to issue those patents. To then force this same Examiner to sign a statement two weeks after the fact denying that "for those claims that are supported by the data, the PTO agrees to issue those claims" is, frankly, embarrassing.

Other ineffective arguments, such as those made by Examiner Kalafut that "the present Examiner did not commit to any agreements during the interview," are also disappointing and, hopefully, will not be repeated. [See Advisory Action dated April 2, 2003 filed in U.S. App'n Ser. No. 08/467,911.] Applicant acknowledges that, to the best of his recollection, Examiner Kalafut, although present at the February 11 Interview, did not speak a word. As previously indicated, it was Specialist McGinty who led the Interview on behalf of the PTO and it was he who ultimately agreed to the terms under which examination of BlackLight's patent applications would proceed, which terms were expressly reduced to writing. For Examiner Kalafut, or any other Examiner assigned to one of BlackLight's applications, to now attempt to distance themselves from that agreement based on the weak assertion that they did not personally commit to it during

the Interview merely illustrates yet another example of the PTO's arbitrary and capricious approach to examining these applications.

Applicant's Identification of Scientific Data Supporting Lower energy States of Hydrogen Generated and Furnished By Independent Third-Parties

In light of the controversial prosecution history of this and other pending BlackLight cases, Applicant appreciated what seemed to be Specialist McGinty's willingness to set reasonable standards and guidelines by which Applicant's patents could finally be issued. Applicant acknowledged and documented Specialist McGinty's concern over the reliability of the record evidence, which led to his requirement that Applicant identify independent third-party verification of the scientific data as noted in the PTO's Supplement to Interview Summary. With those standards and guidelines in mind, Applicant presented in two pending applications a summary of the scientific data supporting lower energy states of hydrogen generated and furnished by independent third parties, which data is reproduced below along with additional, newly submitted data.[115]

Experimental Evidence Generated by Independent Third Parties

Applicant is unaware of any statutes, rules, or case law requiring that experimental evidence submitted by an Applicant in response to a rejection by the PTO be generated by independent third parties. Despite the higher standard imposed by Specialist McGinty requiring such third-party validation of the evidence, Applicant still has met and far exceeded this standard as shown below.

Applicant provides the following alphabetical list of independent third-party laboratories and universities that conducted the experiments and generated the scientific data relied upon and discussed in the analytical studies that follow this list:

Advanced Research - Pirelli Labs, Milan, Italy

Aero Propulsion and Power Directorate, Wright Laboratory, Air Force Material Command (ASC), Wright-Patterson Air Force Base

[115] See U.S. App'n Ser. Nos. 09/110,678 and 09/362,693.

Atomic Energy Canada Limited, Chalk River Laboratories

Brookhaven National Laboratory

Charles Evans & Associates, Sunnyvale, CA

Charles Evans East, East Windsor, NJ

Environmental Catalysis and Materials Laboratory of Virginia Polytechnic Institute

Franklin and Marshall College

Galbraith Laboratories, Inc., Knoxville, TN

Grace Davison, Columbia, MD

IC Laboratories, Amawalk, NY

Idaho National Engineering Laboratory

Institut für Niedertemperatur-Plasmaphysik e.V. (INP Greifswald, Germany)

Jobin Yvon Inc., Edison, NJ

Laboratory for Electrochemistry of Renewed Electrode-Solution Interface (LEPGER)

Liebert Corporation, Division of Emerson Corporation

Los Alamos National Laboratory

Material Testing Laboratory, Pennington, NJ

MIT Lincoln Laboratories

Moscow Power Engineering Institute

NASA Lewis

National Research Council of Canada

PacifiCorp

Pennsylvania State University Chemical Engineering Department

Perkin-Elmer Biosystems, Framingham, MA

Pirelli Labs, Milan, Italy

Ricerca, Inc., Painesville, Ohio

Rider University, Lawrenceville NJ

Rowan University Professors A. J. Marchese, P. M. Jansson, J. L. Schmalzel

Ruhr University, Bochum, Germany

Shrader Analytical & Consulting Laboratories

Spectral Data Services, Inc., Champaign, IL

S. S. W., University of Western Ontario, Canada

Surface Science Laboratories, Mountain View, CA

Thermacore, Inc., Lancaster, PA

University of Delaware, Wilmington, DE

University of Massachusetts Amherst, Amherst, MA

University of New Mexico

Westinghouse Electric Corporation

Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA

The following 47 abstracts briefly describe the analytical studies of the scientific data generated by these independent third parties (highlighted in underline).

Independent Test Results

51. **J. Phillips, C-K Chen, R. Mills, "Evidence of catalytic Production of Hot Hydrogen in RF Generated Hydrogen/Argon Plasmas", IEEE Transactions on Plasma Science, submitted.**

J. Phillips, Distinguished National Laboratory Professor at Los Alamos National Laboratory and University of New Mexico, performed verification studies of line broadening in catalysis plasmas. This is the third in a series of papers by our team on apparently anomalous Balmer series line broadening in hydrogen containing RF generated, low pressure (< 600 mTorr) plasmas. In this paper the selective broadening of the atomic hydrogen lines in pure H2 and Ar/H2 mixtures in a large "GEC" cell (36 cm length X 14 cm ID) was mapped as a function of position, H2/Ar ratio, time, power, and pressure. Several observations regarding the selective line broadening were particularly notable as they are unanticipated on the basis of earlier models. First, the anomalous broadening of the Balmer lines was found to exist throughout the plasma, and not just in the region between the electrodes. Second, the broadening was consistently a complex function of the operating parameters particularly gas composition (highest in pure H2) position, power and pressure. Clearly not anticipated by earlier models were the findings that under some conditions the highest concentration of "hot" (>10 eV) hydrogen was found at the entry end, and not in the high field region between the electrodes and that in other conditions, the hottest H was at the (exit) pump (also grounded electrode) end. Third, excitation and electron temperatures were less than one eV in all regions of the plasma not directly adjacent (>1mm) to the electrodes, providing additional evidence that the energy for broadening, contrary to standard models, is not obtained from the field. Fourth, in contrast to our earlier studies of hydrogen/helium and water plasmas, we found that in some conditions 98% of the atomic hydrogen was in the "hot" state throughout the GEC cell. Virtually every operating parameter studied impacted the character of the hot H atom population, and clearly second and third order effects exist, indicating a need for experimental design. Some non-field mechanisms for generating hot hydrogen atoms, specifically those suggested by Mills' CQM model, are outlined.

50. **J. Phillips, C. K. Chen, R. Mills, "Evidence of the Production of Hot Hydrogen Atoms in RF Plasmas by Catalytic Reactions Between Hydrogen and Oxygen Species", Spectrochimica Acta Part B: Atomic Spectroscopy, submitted.**

J. Phillips, Distinguished National Laboratory Professor at Los Alamos National Laboratory and University of New Mexico, performed verification studies of line broadening in catalysis plasmas. Selective H-atom line broadening was found to be present throughout the volume (13.5 cm ID x 38 cm length) of RF generated H_2O plasmas in a GEC cell. Notably, at low pressures (ca. <0.08 Torr), a significant fraction (ca. 20%) of the atomic hydrogen was 'hot' with energies greater than 40 eV with a pressure dependence, but only a weak power dependence. The degree of broadening was virtually independent of the position studied within the GEC cell, similar to the recent finding for He/H_2 plasmas in the same GEC cell. In contrast to the atomic hydrogen lines, no broadening was observed in oxygen species lines at low pressures. Also, in 'control' Xe/H_2 plasmas run in the same cell at similar pressures and adsorbed power, no significant broadening of atomic hydrogen, Xe, or any other lines was observed. Stark broadening or acceleration of charged species due to high electric fields can not explain the results since i) the electron density was insufficient by orders of magnitude, ii) the RF field was essentially confined to the cathode fall region in contrast to the broadening that was independent of position, and iii) only the atomic hydrogen lines were broadened. Rather, all of the data is consistent with a model that claims specific, predicted, species can act catalytically through a resonant energy transfer mechanism to create 'hot' hydrogen atoms in plasmas.

49. **R. L. Mills, Y. Lu, B. Dhandapani, "Spectral Identification of $H_2(1/2)$", submitted.**

Lower-energy molecular hydrogen lines were independently recorded and interpreted by Stephan Fuelling of the University of Nevada, Reno and the Nevada Terawatt Facility and provided to BlackLight. Novel emission lines with energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,\ or\ 11$ were previously observed by extreme ultraviolet (EUV) spectroscopy recorded on microwave discharges of helium with 2% hydrogen [R. L. Mills, P. Ray, J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542]. These lines matched $H(1/p)$, fractional Rydberg states of atomic hydrogen

wherein $n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, ..., \frac{1}{p}$; ($p \leq 137$ is an integer) replaces the well known parameter n = integer in the Rydberg equation for hydrogen excited states. Evidence supports that these states are formed by a resonant nonradiative energy transfer to He^{+} acting as a catalyst; whereas, krypton, xenon, and their ions serve as controls. Two $H(1/2)$ may react to form $H_2(1/2)$ with emission of the bond energy from a resonant state within its transition state with vibration-rotational energies that are the same as those of H_2. A series of vibration-rotational bands in the 60-67 nm region, a high-energy region for which vibration-rotational spectra are ordinarily unknown, was observed from low-pressure helium-hydrogen (99/1%) microwave plasmas that matched the predicted energy spacing of the vibrational energy of H_2 about the bond energy of $H_2(1/2)$ corresponding to the reaction $2H(1/2) \rightarrow H_2(1/2)$.

48. **J. Phillips, C. K. Chen, "Evidence of Energetic Reaction Between Helium and Hydrogen Species in RF Generated Plasmas", Philosophy Magazine, submitted.**

A study of the line shapes of hydrogen Balmer series lines in RF generated low pressure H_2/He plasmas performed at the University of New Mexico, Department of Chemical and Nuclear Engineering produced results suggesting a catalytic process between helium and hydrogen species results in the generation of 'hot' (ca. 28 eV) atomic hydrogen. Even far from the electrodes (ca. 15 cm) both 'cold' (<2.5 eV) and 'hot' atomic hydrogen were found in H_2/He plasmas. Line shapes, relative line areas of cold and hot atomic hydrogen (hot/cold>2.5), were very similar for areas between the electrodes and far from the electrodes for these plasmas. In contrast, in H_2/Xe only 'warm' (<5 eV) hydrogen (warm/cold<1.0) was found between the electrodes, and only cold hydrogen away from the electrodes. Earlier postulates that preferential hydrogen line broadening in plasmas results from the acceleration of ionic hydrogen in the vicinity of electrodes, and the special charge exchange characteristics of Ar/H_2^{+} are clearly belied by the present results that show atomic hydrogen line shape are similar for H_2/He plasmas throughout the relatively large cylindrical (14 cm ID x 36 cm length) cavity.

47. **R. L. Mills, P. Ray, M. Nansteel, J. He, X. Chen, A. Voigt, B. Dhandapani, Luca Gamberale, "Energetic Catalyst-Hydrogen Plasma Reaction as a Potential New Energy Source", J. Phys. B: At. Mol. Opt. Phys., submitted.**

Luca Gamberale of the Advanced Research - Pirelli Labs, Milan, Italy performed verification studies as a visiting researcher at BlackLight Power, Cranbury, NJ. The prior reported results of BlackLight Power, Inc. of a chemically generated hydrogen plasma, extraordinarily broadened atomic hydrogen lines, lower-energy hydrogen molecular-ion lines, the isolation and characterization of lower-energy molecular hydrogen gas, and excess power measured by water bath calorimetry were replicated. Specifically, plasmas of certain catalysts such as Sr^+, Ar^+, and He^+ mixed with hydrogen were studied for evidence of a novel energetic reaction. A hydrogen plasma was observed to form at low temperatures (e.g. $\approx 10^3\ K$) and an extraordinary low field strength of about 1-2 V/cm when argon and strontium were present with atomic hydrogen. RF and microwave plasmas were used to generate He^+ and Ar^+ catalysts. Extraordinarily fast H (40-50 eV) was observed by Balmer α line broadening only from plasmas having a catalyst with H. Novel emission lines with energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,\ or\ 11$ were previously observed by extreme ultraviolet (EUV) spectroscopy recorded on microwave discharges of helium with 2% hydrogen [R. L. Mills, P. Ray, J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542]. These lines matched $H(1/p)$, fractional Rydberg states of atomic hydrogen wherein $n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \ldots, \frac{1}{p}$; ($p \leq 137$ is an integer) replaces the well known parameter $n = \text{integer}$ in the Rydberg equation for hydrogen excited states. $H(1/p)$ may react with a proton and two $H(1/p)$ may react to form $H_2(1/p)^+$ and $H_2(1/p)$, respectively, that have vibrational and rotational energies that are p^2 times those of the species comprising uncatalyzed atomic hydrogen. A series of over twenty peaks in the 10-65 nm region emitted from low-pressure helium-hydrogen (90/10%) and argon-hydrogen (90/10%) microwave plasmas matched the energy spacing of 2^2 times the transition-state vibrational energy of H_2^+ with the series ending on the bond energy of $H_2(1/4)^+$. $H_2(1/p)$ gas was isolated

by liquefaction using an high-vacuum (10^{-6} Torr) capable, liquid nitrogen cryotrap and was characterized by gas chromatography (GC), mass spectroscopy (MS), visible and EUV optical emission spectroscopy (OES), and ^1H NMR of the condensable gas dissolved in $CDCl_3$. Novel peaks were observed by cryogenic gas chromatography performed on the condensable gas which was highly pure hydrogen by MS and had a higher ionization energy than H_2. The observation that the EUV emission spectrum changed with deuterium substitution in a region where no hydrogen emission has ever been observed further supported the existence of lower-energy molecular hydrogen. Contaminants and exotic helium-hydrogen species were eliminated as the source of the reaction and condensed gas plasma emission spectra. Upfield shifted NMR peaks were observed at 3.47 ppm and 2.18 ppm compared to that of H_2 at 4.63 ppm that matched $H_2(1/2)$ and $H_2(1/4)$, respectively. Excess power was absolutely measured from the helium-hydrogen plasma. For an input of 44.3 W, the total plasma power of the helium-hydrogen plasma measured by water bath calorimetry was 62.9 W corresponding to 18.6 W of excess power in 3 cm^3. The excess power density and energy balance were high, $6.2\ W/cm^3$ and $-5\ X\ 10^4\ kJ/mole\ H_2$ ($240\ eV/H\ atom$), respectively.

46. **R. L. Mills, Y. Lu, J. He, M. Nansteel, P. Ray, X. Chen, A. Voigt, B. Dhandapani, "Spectral Identification of New States of Hydrogen", J. Mol. Struct., submitted.**

Novel emission lines with energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,11$ were previously observed by extreme ultraviolet (EUV) spectroscopy recorded on microwave discharges of helium with 2% hydrogen [R. L. Mills, P. Ray, J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542]. These lines matched $H(1/p)$, fractional Rydberg states of atomic hydrogen wherein $n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \ldots, \frac{1}{p}$; ($p \leq 137$ is an integer) replaces the well known parameter $n = \text{integer}$ in the Rydberg equation for hydrogen excited states. Evidence supports that these states are formed by a resonant nonradiative energy transfer to He^+ acting as a catalyst. Ar^+ also serves as a catalyst to form $H(1/p)$; whereas, krypton, xenon, and their ions serve as controls. $H(1/p)$ may react with a proton and two $H(1/p)$ may react to form $H_2(1/p)^+$ and $H_2(1/p)$, respectively, that have

vibrational and rotational energies that are p^2 times those of the species comprising uncatalyzed atomic hydrogen. A series of over twenty peaks in the 10-65 nm region emitted from low-pressure helium-hydrogen (90/10%) and argon-hydrogen (90/10%) microwave plasmas matched the energy spacing of 2^2 times the transition-state vibrational energy of H_2^+ with the series ending on the bond energy of $H_2(1/4)^+$. Rotational lines were observed in the 145-300 nm region from atmospheric pressure electron-beam excited argon-hydrogen plasmas. The unprecedented energy spacing of 4^2 times that of hydrogen established the internuclear distance as 1/4 that of H_2 and identified $H_2(1/4)$. The results were independently recorded at Rutgers University. $H_2(1/p)$ gas was isolated by liquefaction at liquid nitrogen temperature and by decomposition of compounds found to contain the corresponding hydride ions $H^-(1/p)$. The $H_2(1/p)$ gas was dissolved in $CDCl_3$ and characterized by ^1H NMR at Rider University, Lawrenceville NJ. Considering solvent effects, singlet peaks upfield of H_2 were observed with a predicted integer spacing of 0.64 ppm at 3.47, 3.02, 2.18, 1.25, 0.85, and 0.22 ppm which matched the consecutive series $H_2(1/2)$, $H_2(1/3)$, $H_2(1/4)$, $H_2(1/5)$, $H_2(1/6)$, and $H_2(1/7)$, respectively. Excess power was absolutely measured from the helium-hydrogen plasma. For an input of 41.9 W, the total plasma power of the helium-hydrogen plasma measured by water bath calorimetry was 62.1 W corresponding to 20.2 W of excess power in 3 cm^3 plasma volume. The excess power density and energy balance were high, $6.7\ W/cm^3$ and $-5.4\ X10^4\ kJ/mole\ H_2$ ($280\ eV/H\ atom$), respectively. In addition to power applications, battery and propellant reactions are proposed that may be transformational, and observed excited vibration-rotational levels of $H_2(1/4)$ could be the basis of a UV laser that could significantly advance photolithography.

45. **Dr. K.D. Keefer, Report on BlackLight Power Technology: Its Apparent Scientific Basis, State of Development and Stability for Commercialization by Liebert Corporation, (2001), and, Report on BlackLight Power Technology: Its**

Apparent Scientific Basis, State of Development and Stability for Commercialization, (2002).

To separate reports disclosing the results of NMR, ToF-SIMS, XPS identification of novel hydrino hydride compounds and analysis of chemically-produced plasma by an expert hired by the Liebert Corporation, a division of the well-known and highly-respected Emerson Corporation. According to the expert's own words, he "observed demonstrations of the BlackLight Power (BLP) process and ...reached the inescapable conclusion that it is based on extraordinary chemical reactions that seem to release extraordinary amounts of energy.... It is [his] professional opinion that the BLP process represents a chemical conversion of atomic hydrogen unlike any previously reported [in] the archival scientific literature." Although the expert states that he was skeptical of Applicant's theory, he admitted that the chemical and plasma data did support Applicant's fractional quantum states and that he could offer no other explanation of the data using conventional quantum theory.

44. **A. J. Marchese, P. M. Jansson, J. L. Schmalzel, "The BlackLight Rocket Engine", Phase I Final Report, NASA Institute for Advanced Concepts Phase I, May 1-November 30, 2002, http://www.niac.usra.edu/files/studies/final_report/pdf/752Marchese.pdf.**

Rowan University Professors A. J. Marchese, P. M. Jansson, J. L. Schmalzel performed verification studies as visiting researchers at BlackLight Power, Cranbury, NJ. The prior reported results of BlackLight Power, Inc. of extraordinarily broadened atomic hydrogen lines, population inversion, lower-energy hydrogen lines, and excess power measured by water bath calorimetry were replicated. The application of the energetic hydrogen to propulsion was studied.

Specifically, the data supporting hydrinos was replicated. See

i.) BlackLight Process Theory (pp. 10-12) which gives the theoretical energy levels for hydrinos and the catalytic reaction to form hydrinos,

ii.) Unique Hydrogen Line Broadening in Low Pressure Microwave Water Plasmas (pp. 25-27, particularly Fig. 21) which shows that in the same microwave cavity driven at the same power, the temperature of the hydrogen atoms in the microwave

plasma where the hydrino reaction was active was 50 times that of the control based on the spectroscopic line widths,

iii.) Inversion of the Line Intensities in Hydrogen Balmer Series (pp. 27-28, particularly Fig. 22) which shows for the first time in 40 years of intensive worldwide research that atomic hydrogen population inversion was achieved in a steady state plasma and supports the high power released from the reaction of hydrogen to form hydrinos,

iv.) Novel Vacuum Ultraviolet (VUV) Vibration Spectra of Hydrogen Mixture Plasmas (pp. 28-29, particularly Fig. 23) which shows a novel vibrational series of lines in a helium-hydrogen plasmas at energies higher than any known vibrational series and it identically matches the theoretical prediction of 2 squared times the corresponding vibration of the ordinary hydrogen species, and

v.) Water Bath Calorimetry Experiments Showing Increased Heat Generation (pp. 29-30, particularly Fig. 25) that shows that with exactly the same system and same input power, the heating of the water reservoir absolutely measured to 1% accuracy was equivalent to 55 to 62 W with the catalyst-hydrogen mixture compared to 40 W in the control without the possibility of the reaction to form hydrinos.

43. **J. Phillips, R. L. Mills, X. Chen, "Water Bath Calorimetric Study of Excess Heat in 'Resonance Transfer' Plasmas", Journal of Applied Physics, Vol. 96, No. 6, pp. 3095-3102.**

J. Phillips, Distinguished National Laboratory Professor at Los Alamos National Laboratory and University of New Mexico, performed verification studies as a visiting researcher at BlackLight Power, Cranbury, NJ. Water bath calorimetry was used to demonstrate one more peculiar phenomenon associated with a certain class of mixed gas plasmas termed resonant transfer, or rt-plasmas. Specifically, He/H_2(10%) (500 mTorr), Ar/H_2(10%) (500 mTorr), and $H_2O(g)$ (500 mTorr and 200 mTorr) plasmas generated with an Evenson microwave cavity consistently yielded on the order of 50% more heat than non rt-plasma (controls) such as He, Kr, Kr/H_2(10%), under identical conditions of gas flow, pressure, and microwave operating conditions. The excess

power density of rt-plasmas was of the order $10\ W \cdot cm^{-3}$. In earlier studies with these same rt-plasmas it was demonstrated that other unusual features were present including dramatic broadening of the hydrogen Balmer series lines, unique vacuum ultraviolet (VUV) lines, and in the case of water plasmas, population inversion of the hydrogen excited states. Both the current results and the earlier results are completely consistent with the existence of a hitherto unknown exothermic chemical reaction, such as that predicted by Mills, occurring in rt-plasmas.

42. **R. L. Mills, P. C. Ray, R. M. Mayo, M. Nansteel, B. Dhandapani, J. Phillips, "Spectroscopic Study of Unique Line Broadening and Inversion in Low Pressure Microwave Generated Water Plasmas", J. Plasma Phys., submitted.**

J. Phillips, Distinguished National Laboratory Professor at Los Alamos National Laboratory and University of New Mexico, performed verification studies as a visiting researcher at BlackLight Power, Cranbury, NJ. It was demonstrated that low pressure ($\sim$0.2 Torr) water vapor plasmas generated in a 10 mm ID quartz tube with an Evenson microwave cavity show at least two features which are not explained by conventional plasma models. First, significant (> 2.5 Å) hydrogen Balmer α line broadening was recorded, of constant width, up to 5 cm from the microwave coupler. Only hydrogen, and not oxygen, showed significant line broadening. This feature, observed previously in hydrogen-containing mixed gas plasmas generated with high voltage DC and RF discharges was explained by some researchers to result from acceleration of hydrogen ions near the cathode. This explanation cannot apply to the line broadening observed in the (electrodeless) microwave plasmas generated in this work, particularly at distances as great as 5 cm from the microwave coupler. Second, dramatic inversion of the line intensities of both the Lyman and Balmer series, again, at distances up to 5 cm from the coupler were observed. The dramatic line inversion suggests the existence of a hitherto unknown source of pumping of the optical power in plasmas. Finally, it is notable that other aspects of the plasma including the OH^* rotational temperature and low electron concentrations are quite typical of plasmas of this type.

41. **H. Conrads, R. Mills, Th. Wrubel, "Emission in the Deep Vacuum Ultraviolet from a Plasma Formed by Incandescently Heating Hydrogen Gas with Trace Amounts of Potassium Carbonate", Plasma Sources Science and Technology, Vol. 12, (2003), pp. 389-395.**

The generation of a hydrogen plasma with intense extreme ultraviolet and visible emission was observed at Ruhr University, Bochum, Germany from low pressure hydrogen gas (0.1-1 mbar) in contact with a hot tungsten filament only when the filament heated a titanium dissociator coated with K_2CO_3 above 750°C. The dissociator was electrically floated, and the electric field strength from the filament was about 1 V/cm, two orders of magnitude lower than the starting voltages measured for gas glow discharges. The emission of the H_α and H_β transitions as well as the L_α and L_β transitions were recorded and analyzed. The plasma seemed to be far from thermal equilibrium, and no conventional mechanism was found to explain the formation of a hydrogen plasma by incandescently heating hydrogen gas with the presence of trace amounts of K_2CO_3. The temporal behavior of the plasma was recorded via hydrogen Balmer alpha line emission when all power into the cell was terminated. A two second decay of the plasma was observed after a fast decay of the electric field to zero. The plasma was found to be dependent on the chemistry of atomic hydrogen with potassium since no plasma formed with Na_2CO_3 replacing K_2CO_3 and the time constant of the emission following the removal of all of the power to the cell matched that of the cooling of the filament and the resulting shift from atomic to molecular hydrogen. Our results indicate that a novel chemical power source is present that forms the energetic hydrogen plasma. The plasma is a potential new light source.

40. **R. Mills, "Observation of Extreme Ultraviolet Emission from Hydrogen-KI Plasmas Produced by a Hollow Cathode Discharge", Int. J. Hydrogen Energy, Vol. 26, No. 6, (2001), pp. 579-592.**

A high voltage discharge of hydrogen with and without the presence of a source of potassium, potassium iodide, in the discharge was performed at Institut für Niedertemperatur-Plasmaphysik e.V. (INP Greifswald, Germany) with a hollow cathode.

It has been reported that intense extreme ultraviolet (EUV) emission was observed at low temperatures (e.g. $< 10^3\ K$) from atomic hydrogen and certain atomized elements or certain gaseous ions which ionize at integer multiples of the potential energy of atomic hydrogen, $27.2\ eV$ [1, 3-5]. Two potassium ions or a potassium atom may each provide an electron ionization or transfer reaction that has a net enthalpy equal to an integer multiple of $27.2\ eV$. The spectral lines of atomic hydrogen were intense enough to be recorded on photographic films only when KI was present. EUV lines not assignable to potassium, iodine, or hydrogen were observed at 73.0, 132.6, 513.6, 677.8, 885.9, and 1032.9 Å. The lines are assigned to transitions of atomic hydrogen to lower energy levels corresponding to lower energy hydrogen atoms called hydrino atoms and the emission from the excitation of the corresponding hydride ions formed from the hydrino atoms.

39. **R. Mills, "Temporal Behavior of Light-Emission in the Visible Spectral Range from a Ti-K_2CO_3-H-Cell', Int. J. Hydrogen Energy, Vol. 26, No. 4, (2001), pp. 327-332.**

<u>Institut für Niedertemperatur-Plasmaphysik e.V. (INP Greifswald, Germany)</u> reports the generation of a hydrogen plasma and extreme ultraviolet emission as recorded via the hydrogen Balmer emission in the visible range. Typically a hydrogen plasma is generated and the emission of extreme ultraviolet light from hydrogen gas is achieved via a discharge at high voltage, a high power inductively coupled plasma, or a plasma created and heated to extreme temperatures by RF coupling (e.g. $> 10^6\ K$) with confinement provided by a toroidal magnetic field. The observed plasma formed at low temperatures (e.g. $\approx 10^3\ K$) from atomic hydrogen generated at a tungsten filament that heated a titanium dissociator coated with potassium carbonate. The temporal behavior of the plasma was recorded via hydrogen Balmer alpha line emission when all power into the cell was terminated. A two second decay of the plasma was observed after a fast decay of the electric field to zero. The persistence of emission following the removal of all of the power to the cell indicates that a novel chemical power source is

present that forms an energetic plasma in hydrogen. No unusual behavior was observed with the control sodium carbonate.

38. **R. Mills, J. Sankar, A. Voigt, J. He, P. Ray, B. Dhandapani, "Synthesis and Characterization of Diamond Films from MPCVD of an Energetic Argon-Hydrogen Plasma and Methane", Materials Science, submitted.**

Polycrystalline diamond films were synthesized on silicon substrates by a low power (~80 W) microwave plasma chemical vapor deposition (MPCVD) reaction of a mixture of argon-hydrogen-methane (17.5/80/2.5%). The films were characterized by time of flight secondary ion mass spectroscopy (ToF-SIMS), X-ray photoelectron spectroscopy (XPS) (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA), Raman spectroscopy (Charles Evans & Associates, Sunnyvale, CA), scanning electron microscopy (SEM) (S. S. W., University of Western Ontario, Canada), and X-ray diffraction (XRD) (IC Laboratories, Amawalk, NY). It is proposed that Ar^+ served as a catalyst with atomic hydrogen to form an energetic plasma. CH, C_2, and C_3 emissions were observed with significantly broadened H α line. The average hydrogen atom temperature of a argon-hydrogen-methane plasma was measured to be $110 - 130\ eV$ versus $\approx 3\ eV$ for pure hydrogen. Bombardment of the carbon surface by highly energetic hydrogen formed by the catalysis reaction may play a role in the formation of diamond. Then, by this novel pathway, the relevance of the CO tie line is eliminated along with other stringent conditions and complicated and inefficient techniques which limit broad application of the versatility and superiority of diamond thin film technology.

37. **R. Mills, P. Ray, B. Dhandapani, W. Good, P. Jansson, M. Nansteel, J. He, A. Voigt, "Spectroscopic and NMR Identification of Novel Hydride Ions in Fractional Quantum Energy States Formed by an Exothermic Reaction of Atomic Hydrogen with Certain Catalysts", J. Phys. Chem. A, submitted.**

$2K^+$ to $K + K^{2+}$ and K to K^{3+} provide a reaction with a net enthalpy equal to the one and three times the potential energy of atomic hydrogen, respectively. The

presence of these gaseous ions or atoms with thermally dissociated hydrogen formed a so-called resonance transfer (rt) plasma having strong VUV emission with a stationary inverted Lyman population. Significant line broadening of the Balmer α, β, and γ lines of 18 eV was observed, compared to 3 eV from a hydrogen microwave plasma. Emission from rt-plasmas occurred even when the electric field applied to the plasma was zero as recorded at Institut für Niedertemperatur-Plasmaphysik e.V. (INP Greifswald, Germany. The reaction was exothermic since excess power of 20 $mW \cdot cm^{-3}$ was measured by Calvet calorimetry. An energetic catalytic reaction was proposed involving a resonant energy transfer between hydrogen atoms and $2K^+$ or K to form very stable novel hydride ions $H^-(1/p)$ called hydrino hydrides having a fractional principal quantum numbers $p = 2$ and $p = 4$, respectively. Characteristic emission was observed from K^{2+} and K^{3+} that confirmed the resonant nonradiative energy transfer of $27.2\ eV$ and $3 \cdot 27.2\ eV$ from atomic hydrogen to $2K^+$ and K, respectively.

The predicted binding energy of $H^-(1/2)$ of $3.0471\ eV$ with the fine structure was observed at 4071 Å, and its predicted bound-free hyperfine structure lines $E_{HF} = j^2 3.00213\, X\, 10^{-5} + 3.0563\ eV$ (j is an integer) matched those observed for $j = 1$ to $j = 37$ to within a 1 part per 10^4. $H^-(1/4)$ was observed spectroscopically at $110\ nm$ corresponding to its predicted binding energy of $11.2\ eV$. The ^1H MAS NMR spectrum (Spectral Data Services, Inc., Champaign, IL) of novel compound $KH*Cl$ relative to external tetramethylsilane (TMS) showed a large distinct upfield resonance at -4.4 corresponding to an absolute resonance shift of -35.9 ppm that matched the theoretical prediction of p = 4. A novel NMR (Grace Davison, Columbia, MD and Spectral Data Services, Inc., Champaign, IL) peak of $KH*I$ at -1.5 ppm relative to TMS corresponding to an absolute resonance shift of -33.0 ppm matched the theoretical prediction of p = 2. The predicted catalyst reactions, position of the upfield-shifted NMR peaks, and spectroscopic data for $H^-(1/2)$ and $H^-(1/4)$ were found to be in agreement.

36. **R. L. Mills, P. Ray, B. Dhandapani, J. He, "Novel Liquid-Nitrogen-Condensable Molecular Hydrogen Gas", Acta Physica Polonica A, submitted.**

Extreme ultraviolet (EUV) spectroscopy was recorded on microwave discharges of helium with 2% hydrogen. Novel emission lines were observed with energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,11$ or these discrete energies less $21.2\ eV$ corresponding to inelastic scattering of these photons by helium atoms due to excitation of $He\,(1s^2)$ to $He\,(1s^1 2p^1)$. These lines matched $H(1/p)$, fractional Rydberg states of atomic hydrogen, formed by a resonant nonradiative energy transfer to He^+. Corresponding emission due to the reaction $2H(1/2) \rightarrow H_2(1/2)$ with vibronic coupling at $E_{D+vib} = p^2 E_{D\,H_2} \pm \left(\frac{\upsilon^*}{3}\right) E_{vib\ H_2(\upsilon=0\rightarrow\upsilon=1)}$, $\upsilon^* = 1,2,3...$ was observed at the longer wavelengths for $\upsilon^* = 2$ to $\upsilon^* = 32$ and at the shorter wavelengths for $\upsilon^* = 1$ to $\upsilon^* = 16$ where $E_{D\,H_2}$ and $E_{vib\,H_2(\upsilon=0\rightarrow\upsilon=1)}$ are the experimental bond and vibrational energies of H_2, respectively. Fractional-principal-quantum-level molecular hydrogen $H_2(1/p)$ gas was isolated by liquefaction using an ultrahigh-vacuum, liquid nitrogen cryotrap and was characterized by gas chromatography (GC), mass spectroscopy (MS), optical emission spectroscopy (OES), and ^1H NMR (Rider University, Lawrenceville NJ) of the condensable gas dissolved in $CDCl_3$. The condensable gas was highly pure hydrogen by GC and MS and had a higher ionization energy than H_2. An upfield shifted NMR peaks were observed at 3.47 and 2.18 ppm compared to that of H_2 at 4.63 ppm. A theoretical rocketry propellant reaction is given that may be transformational.

35. **R. L. Mills, J. Sankar, A. Voigt, J. He, B. Dhandapani, "Spectroscopic Characterization of the Atomic Hydrogen Energies and Densities and Carbon Species During Helium-Hydrogen-Methane Plasma CVD Synthesis of Single Crystal Diamond Films", Chemistry of Materials, Vol. 15, (2003), pp. 1313-1321.**

Polycrystalline diamond films were synthesized on silicon substrates for the first time without diamond seeding by a very low power (38 W) microwave plasma continuous vapor deposition (MPCVD) reaction of a mixture of helium-hydrogen-methane (48.2/48.2/3.6%). The films were characterized by time of flight secondary ion

mass spectroscopy (ToF-SIMS), X-ray photoelectron spectroscopy (XPS) (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA), Raman spectroscopy (Charles Evans & Associates, Sunnyvale, CA and Jobin Yvon Inc., Edison, NJ), scanning electron microscopy (SEM) (S. S. W., University of Western Ontario, Canada and Material Testing Laboratory, Pennington, NJ), and X-ray diffraction (XRD) (IC Laboratories, Amawalk, NY). It is proposed that He^+ served as a catalyst with atomic hydrogen to form an energetic plasma. CH, C_2, and C_3 emissions were observed with significantly broadened H α, β, γ, and δ lines. The average hydrogen atom temperature of a helium-hydrogen-methane plasma was measured to be $120-140\ eV$ versus $\approx 3\ eV$ for pure hydrogen. Bombardment of the carbon surface by highly energetic hydrogen formed by the catalysis reaction may play a role in the formation of diamond. Then, by this novel pathway, the relevance of the CO tie line is eliminated along with other stringent conditions and complicated and inefficient techniques which limit broad application of the versatility and superiority of diamond thin film technology.

34. **R. L. Mills, J. Sankar, A. Voigt, J. He, B. Dhandapani, "Low Power MPCVD of Diamond Films on Silicon Substrates", Journal of Vacuum Science & Technology A, submitted.**

Polycrystalline diamond films were synthesized on silicon substrates for the first time without diamond seeding by a very low power (38 W) microwave plasma continuous vapor deposition (MPCVD) reaction of a mixture of 10-30% hydrogen, 90-70% helium, and 1-10% CH_4. The films were characterized by time of flight secondary ion mass spectroscopy (ToF-SIMS), X-ray photoelectron spectroscopy (XPS) (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA), Raman spectroscopy (Charles Evans & Associates, Sunnyvale, CA), scanning electron microscopy (SEM) (S. S. W., University of Western Ontario, Canada and Material Testing Laboratory, Pennington, NJ), and X-ray diffraction (XRD) (IC Laboratories, Amawalk, NY). It is proposed that He^+ served as a catalyst with atomic hydrogen to form an energetic plasma. The average hydrogen atom temperature was

measured to be $180 - 210\ eV$ versus $\approx 3\ eV$ for pure hydrogen. The electron temperature T_e for helium-hydrogen was 28,000 K compared to 6800 K for pure helium. Bombardment of the carbon surface by highly energetic hydrogen formed by the catalysis reaction may play a role in the formation of diamond. Then, by this novel pathway, the relevance of the CO tie line is eliminated along with other stringent conditions and complicated and inefficient techniques which limit broad application of the versatility and superiority of diamond thin film technology.

33. **R. L. Mills, A. Voigt, B. Dhandapani, J. He, "Synthesis and Spectroscopic Identification of Lithium Chloro Hydride", Materials Characterization, submitted.**

A novel inorganic hydride compound, lithium chloro hydride ($LiHCl$), which comprises a high binding energy hydride ion was synthesized by reaction of atomic hydrogen with potassium metal and lithium chloride. Lithium chloro hydride was identified by time of flight secondary ion mass spectroscopy, X-ray photoelectron spectroscopy (<u>Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA</u>), ^1H nuclear magnetic resonance spectroscopy (<u>Spectral Data Services, Inc., Champaign, IL</u>), and powder X-ray diffraction (<u>IC Laboratories, Amawalk, NY</u>). Hydride ions with increased binding energies may form many novel compounds with broad applications such as the oxidant of a high voltage battery.

32. **R. L. Mills, B. Dhandapani, J. He, "Highly Stable Amorphous Silicon Hydride", Solar Energy Materials & Solar Cells, Vol. 80, No. 1, (2003), pp. 1-20.**

A novel highly stable hydrogen terminated silicon coating was synthesized by microwave plasma reaction of mixture of silane, hydrogen, and helium wherein it is proposed that He^+ served as a catalyst with atomic hydrogen to form highly stable silicon hydrides. Novel silicon hydride was identified by time of flight secondary ion mass spectroscopy and X-ray photoelectron spectroscopy. The time of flight secondary ion mass spectroscopy (ToF-SIMS) identified the coatings as hydride by the large SiH^+ peak in the positive spectrum and the dominant H^- in the negative spectrum. Since

hydrogen is the only element with no primary element peaks, X-ray photoelectron spectroscopy (XPS) (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA) identified the H content of the SiH coatings as comprising novel silicon hydrides due to new peaks at 11, 43, and 55 eV in the absence of corresponding peaks of any candidate element at higher binding energies. The silicon hydride surface was remarkably stable to air as shown by XPS. The highly stable amorphous silicon hydride coating may advance the production of integrated circuits and microdevices by resisting the oxygen passivation of the surface and possibly altering the dielectric constant and band gap to increase device performance.

31. **R. L. Mills, J. Sankar, A. Voigt, J. He, B. Dhandapani, "Synthesis of HDLC Films from Solid Carbon", Thin Solid Films, submitted.**

Diamond-like carbon (DLC) films were synthesized on silicon substrates from solid carbon by a very low power (~60 W) microwave plasma chemical vapor deposition (MPCVD) reaction of a mixture of 90-70% helium and 10-30% hydrogen. It is proposed that He^+ served as a catalyst with atomic hydrogen to form an energetic plasma. The average hydrogen atom temperature of a helium-hydrogen plasma was measured to be $180 - 210\ eV$ versus $\approx 3\ eV$ for pure hydrogen. Bombardment of the carbon surface by highly energetic hydrogen formed by the catalysis reaction may play a role in the formation of DLC. The films were characterized by time of flight secondary ion mass spectroscopy (ToF-SIMS), X-ray photoelectron spectroscopy (XPS) (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA), and Raman spectroscopy (Charles Evans & Associates, Sunnyvale, CA). TOF-SIMS identified the coatings as hydride by the large H^+ peak in the positive spectrum and the dominant H^- in the negative spectrum. The XPS identification of the H content of the CH coatings as a novel hydride corresponding to a peak at 49 eV has implications that the mechanism of the DLC formation may also involve one or both of selective etching of graphitic carbon and the stabilization of sp^3-bonded carbon by the hydrogen catalysis product. Thus, a novel H intermediate formed by the plasma catalysis reaction may enhance the stabilization and etching role of H used in past methods.

30. **R. L. Mills, J. He, P. Ray, B. Dhandapani, X. Chen, "Synthesis and Characterization of a Highly Stable Amorphous Silicon Hydride as the Product of a Catalytic Helium-Hydrogen Plasma Reaction", Int. J. Hydrogen Energy, in press.**

A novel highly stable surface coating $SiH(1/p)$ which comprised high binding energy hydride ions was synthesized by a microwave plasma reaction of a mixture of silane, hydrogen, and helium wherein it is proposed that He^{+} served as a catalyst with atomic hydrogen to form the highly stable hydride ions. Novel silicon hydride was identified by time of flight secondary ion mass spectroscopy and X-ray photoelectron spectroscopy. The time of flight secondary ion mass spectroscopy (ToF-SIMS) identified the coatings as hydride by the large SiH^{+} peak in the positive spectrum and the dominant H^{-} in the negative spectrum. X-ray photoelectron spectroscopy (XPS) (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA) identified the H content of the SiH coatings as hydride ions, $H^{-}(1/4)$, $H^{-}(1/9)$, and $H^{-}(1/11)$ corresponding to peaks at 11, 43, and 55 eV, respectively. The silicon hydride surface was remarkably stable to air as shown by XPS. The highly stable amorphous silicon hydride coating may advance the production of integrated circuits and microdevices by resisting the oxygen passivation of the surface and possibly altering the dielectric constant and band gap to increase device performance.

The plasma which formed $SiH(1/p)$ showed a number of extraordinary features. Novel emission lines with energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,\ or\ 11$ were previously observed by extreme ultraviolet (EUV) spectroscopy recorded on microwave discharges of helium with 2% hydrogen [R. Mills, P. Ray, "Spectral Emission of Fractional Quantum Energy Levels of Atomic Hydrogen from a Helium-Hydrogen Plasma and the Implications for Dark Matter", Int. J. Hydrogen Energy, Vol. 27, No. 3, pp. 301-322]. These lines matched $H(1/p)$, fractional Rydberg states of atomic hydrogen where p is an integer, formed by a resonant nonradiative energy transfer to He^{+} acting as a catalyst. The average hydrogen atom temperature of the helium-hydrogen plasma was measured to be $180-210\ eV$ versus $\approx 3\ eV$ for pure hydrogen.

Using water bath calorimetry, excess power was observed from the helium-hydrogen plasma compared to control krypton plasma. For example, for an input of 8.1 W, the total plasma power of the helium-hydrogen plasma measured by water bath calorimetry was 30.0 W corresponding to 21.9 W of excess power in 3 cm^3. The excess power density and energy balance were high, $7.3\ W/cm^3$ and $-2.9\,X\,10^4\ kJ/mole\,H_2$, respectively. This catalytic plasma reaction may represent a new hydrogen energy source and a new field of hydrogen chemistry.

29. **R. L. Mills, A. Voigt, B. Dhandapani, J. He, "Synthesis and Characterization of Lithium Chloro Hydride", Int. J. Hydrogen Energy, submitted.**

A novel inorganic hydride compound lithium chloro hydride, $LiHCl$, which comprises a high binding energy hydride ion was synthesized by reaction of atomic hydrogen with potassium metal and lithium chloride. Lithium chloro hydride was identified by time of flight secondary ion mass spectroscopy, X-ray photoelectron spectroscopy (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA), ^1H nuclear magnetic resonance spectroscopy (Spectral Data Services, Inc., Champaign, IL), and powder X-ray diffraction (IC Laboratories, Amawalk, NY). Hydride ions with increased binding energies may form many novel compounds with broad applications such as the oxidant of a high voltage battery.

28. **R. Mills, E. Dayalan, P. Ray, B. Dhandapani, J. He, "Highly Stable Novel Inorganic Hydrides from Aqueous Electrolysis and Plasma Electrolysis", Electrochimica Acta, Vol. 47, No. 24, (2002), pp. 3909-3926.**

After 10^4 hours of continuous aqueous electrolysis with K_2CO_3 as the electrolyte, highly stable novel inorganic hydride compounds such as $KH\,KHCO_3$ and KH were isolated and identified by time of flight secondary ion mass spectroscopy (ToF-SIMS) (Charles Evans East, East Windsor, NJ). The existence of novel hydride ions was determined using X-ray photoelectron spectroscopy (XPS) (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA) and solid state magic-angle spinning ^1H nuclear magnetic resonance spectroscopy (^1H MAS NMR)

(Spectral Data Services, Inc., Champaign, IL). A novel ion formed by plasma electrolysis of a K_2CO_3, Rb_2CO_3, or Cs_2CO_3 electrolyte was also observed by high resolution visible spectroscopy at 407.0 nm corresponding to its predicted binding energy of $3.05\ eV$.

27. **R. Mills, B. Dhandapani, M. Nansteel, J. He, A. Voigt, "Identification of Compounds Containing Novel Hydride Ions by Nuclear Magnetic Resonance Spectroscopy", Int. J. Hydrogen Energy, Vol. 26, No. 9, Sept. (2001), pp. 965-979.**

Novel inorganic alkali and alkaline earth hydrides of the formula MH^*, MH_2^*, and MH^*X wherein M is the metal, X, is a halide, and H^* comprises a novel high binding energy hydride ion were synthesized in a high temperature gas cell by reaction of atomic hydrogen with a catalyst and MH, MH_2, or MX corresponding to an alkali metal or alkaline earth metal compound, respectively. Novel hydride ions of the corresponding novel hydride compounds were characterized by an extraordinary upfield shifted peak observed by ^1H nuclear magnetic resonance spectroscopy. The result were confirmed on five different instruments at five independent laboratories (Spectral Data Services, Inc., Champaign, IL, National Research Council of Canada, University of Massachusetts Amherst, Amherst, MA, University of Delaware, Wilmington, DE, and Grace Davison, Columbia, MD).

26. **R. Mills, B. Dhandapani, N. Greenig, J. He, "Synthesis and Characterization of Potassium Iodo Hydride", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1185-1203.**

A novel inorganic hydride compound KHI which comprises a high binding energy hydride ion was synthesized by reaction of atomic hydrogen with potassium metal and potassium iodide. Potassium iodo hydride was identified by time of flight secondary ion mass spectroscopy, X-ray photoelectron spectroscopy (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA), ^1H and ^{39}K nuclear magnetic resonance spectroscopy (Spectral Data Services, Inc.,

Champaign, IL), Fourier transform infrared spectroscopy (Surface Science Laboratories, Mountain View, CA), electrospray ionization time of flight mass spectroscopy (Perkin-Elmer Biosystems, Framingham, MA), liquid chromatography/mass spectroscopy (Ricerca, Inc., Painesville, Ohio), thermal decomposition with analysis by gas chromatography, and mass spectroscopy, and elemental analysis (Galbraith Laboratories, Inc., Knoxville, TN). Hydride ions with increased binding energies may form many novel compounds with broad applications.

25. **R. Mills, "Novel Inorganic Hydride", Int. J. of Hydrogen Energy, Vol. 25, (2000), pp. 669-683.**

A novel inorganic hydride compound $KHKHCO_3$ which is stable in water and comprises a high binding energy hydride ion was isolated following the electrolysis of a K_2CO_3 electrolyte. Inorganic hydride clusters $K[KHKHCO_3]_n^+$ were identified by Time of Flight Secondary Ion Mass Spectroscopy (Charles Evans East, East Windsor, NJ). Moreover, the existence of a novel hydride ion has been determined using X-ray photoelectron spectroscopy (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA), and ^1H nuclear magnetic resonance spectroscopy (Spectral Data Services, Inc., Champaign, IL). Hydride ions with increased binding energies may be the basis of a high voltage battery for electric vehicles.

24. **R. Mills, B. Dhandapani, M. Nansteel, J. He, T. Shannon, A. Echezuria, "Synthesis and Characterization of Novel Hydride Compounds", Int. J. of Hydrogen Energy, Vol. 26, No. 4, (2001), pp. 339-367.**

Novel inorganic alkali and alkaline earth hydrides of the formula MHX and $MHMX$ wherein M is the metal, X, is a singly negatively charged anion, and H comprises a novel high binding energy hydride ion were synthesized in a high temperature gas cell by reaction of atomic hydrogen with a catalyst and MX or MX_2 corresponding to an alkali metal or alkaline earth metal, respectively. It has been reported that intense extreme ultraviolet (EUV) emission was observed at low

temperatures (e.g. $\approx 10^3\ K$) from atomic hydrogen and certain atomized elements or certain gaseous ions which ionize at integer multiples of the potential energy of atomic hydrogen, $27.2\ eV$ [1-5]. These atomized elements or certain gaseous ions comprised the catalyst to form MHX and $MHMX$. For example, atomic hydrogen was reacted with strontium vapor and $SrBr_2$ to form $SrHBr$. Novel hydride compounds such as $SrHBr$ were identified by time of flight secondary ion mass spectroscopy, X-ray photoelectron spectroscopy (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA), ^1H nuclear magnetic resonance spectroscopy (Spectral Data Services, Inc., Champaign, IL), and thermal decomposition with analysis by gas chromatography, and mass spectroscopy. Hydride ions with increased binding energies form novel compounds with potential broad applications such as a high voltage battery for consumer electronics and electric vehicles. In addition, these novel compositions of matter and associated technologies may have far-reaching applications in many industries including chemical, electronics, computer, military, energy, and aerospace in the form of products such as propellants, solid fuels, surface coatings, structural materials, and chemical processes.

23. **R. Mills, "Highly Stable Novel Inorganic Hydrides", Journal of New Materials for Electrochemical Systems, Vol. 6, (2003), pp. 45-54.**

Novel inorganic hydride compounds $KHKHCO_3$ and KH were isolated following the electrolysis of a K_2CO_3 electrolyte. The compounds which comprised high binding energy hydride ions were stable in water, and KH was stable at elevated temperature (600 °C). Inorganic hydride clusters $K[KHKHCO_3]_n^+$ were identified by positive Time of Flight Secondary Ion Mass Spectroscopy (ToF-SIMS) of $KHKHCO_3$ (Charles Evans East, East Windsor, NJ). The negative ToF-SIMS was dominated by hydride ion. The positive and negative ToF-SIMS of KH showed essentially K^+ and H^- only, respectively. Moreover, the existence of novel hydride ions was determined using X-ray photoelectron spectroscopy (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA), and ^1H nuclear magnetic resonance spectroscopy (Spectral Data Services, Inc., Champaign, IL). Hydride ions with

increased binding energies may be the basis of a high voltage battery for electric vehicles.

22. **R. Mills, "Novel Hydrogen Compounds from a Potassium Carbonate Electrolytic Cell", Fusion Technology, Vol. 37, No. 2, March, (2000), pp. 157-182.**

Novel compounds containing hydrogen in new hydride and polymeric states which demonstrate novel hydrogen chemistry have been isolated following the electrolysis of a K_2CO_3 electrolyte with the production of excess energy. Inorganic hydride clusters $K[KH\,KHCO_3]_n^+$ and hydrogen polymer ions such as OH_{23}^+ and H_{16}^- were identified by time of flight secondary ion mass spectroscopy (Charles Evans East, East Windsor, NJ). The presence of compounds containing new states of hydrogen were confirmed by X-ray photoelectron spectroscopy (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA), X-ray diffraction, Fourier transform infrared spectroscopy (Surface Science Laboratories, Mountain View, CA), Raman spectroscopy (Environmental Catalysis and Materials Laboratory of Virginia Polytechnic Institute), and ^1H nuclear magnetic resonance spectroscopy (Spectral Data Services, Inc., Champaign, IL).

21. **Mills, R., Good, W., "Fractional Quantum Energy Levels of Hydrogen", Fusion Technology, Vol. 28, No. 4, November, (1995), pp. 1697-1719.**

Determination of excess heat release during the electrolysis of aqueous potassium carbonate by the very accurate and reliable method of heat measurement, flow calorimetry; describes the experimental identification of hydrogen atoms in fractional quantum energy levels—hydrinos—by X-ray Photoelectron Spectroscopy (XPS) (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA); describes the experimental identification of hydrogen atoms in fractional quantum energy levels—hydrinos—by emissions of soft X-rays from dark matter; describes the experimental identification of hydrogen molecules in fractional

quantum energy levels—dihydrino molecules by high resolution magnetic sector mass spectroscopy with ionization energy determination, and gives a summary.

In summary:

Excess power and heat were observed during the electrolysis of aqueous potassium carbonate. Flow calorimetry of pulsed current electrolysis of aqueous potassium carbonate at a nickel cathode was performed in a single-cell dewar. The average power out of 24.6 watts exceeded the average input power (voltage times current) of 4.73 watts by a factor greater than 5. The total input energy (integration of voltage times current) over the entire duration of the experiment was 5.72 MJ; whereas, the total output energy was 29.8 MJ. No excess heat was observed when the electrolyte was changed from potassium carbonate to sodium carbonate. The source of heat is assigned to the electrocatalytic, exothermic reaction whereby the electrons of hydrogen atoms are induced to undergo transitions to quantized energy levels below the conventional "ground state". These lower energy states correspond to fractional quantum numbers: n = 1/2, 1/3, 1/4, ... Transitions to these lower energy states are stimulated in the presence of pairs of potassium ions (K^+/K^+ electrocatalytic couple) which provide 27.2 eV energy sinks.

The identification of the n = 1/2 hydrogen atom , H(n = 1/2) is reported. Samples of the nickel cathodes of aqueous potassium carbonate electrolytic cells and aqueous sodium carbonate electrolytic cells were analyzed by XPS (Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA). A broad peak centered at 54.6 eV was present only in the cases of the potassium carbonate cells. The binding energy (in vacuum) of H(n = 1/2) is 54.4 eV. Thus, the theoretical and measured binding energies for H(n = 1/2) are in excellent agreement.

Further experimental identification of hydrinos—down to H(n = 1/8)—can be found in the alternative explanation by Mills et al. for the soft X-ray emissions of the dark interstellar medium observed by Labov and Bowyer [Labov, S., Bowyer, S., "Spectral observations of the extreme ultraviolet background", The Astrophysical Journal, 371, (1991), pp. 810-819] of the Extreme UV Center of the University of California, Berkeley.

The agreement between the experimental spectrum and the energy values predicted for the proposed transitions is remarkable.

The reaction product of two H(n=1/2) atoms, the dihydrino molecule, was identified by mass spectroscopy (Shrader Analytical & Consulting Laboratories). The mass spectrum of the cryofiltered gases evolved during the electrolysis of a light water K_2CO_3 electrolyte with a nickel cathode demonstrated that the dihydrino molecule, $H_2\left(n=\frac{1}{2}\right)$, has a higher ionization energy, about 63 eV, than normal molecular hydrogen, $H_2(n=1)$, 15.46 eV. The high resolution (0.001 AMU) magnetic sector mass spectroscopic analysis of the postcombustion gases indicated the presence of two peaks of nominal mass two-- one peak at 70 eV and one peak at 25 eV. The same analysis of molecular hydrogen indicates only one peak at 25 eV and one peak at 70 eV. In the case of the postcombustion sample at 70 eV, one peak was assigned as the hydrogen molecular ion peak, $H_2^+(n=1)$, and one peak was assigned as the dihydrino molecular peak, $H_2^+\left(n=\frac{1}{2}\right)$ which has a slightly larger magnetic moment.

20. **Mills, R., Good, W., Shaubach, R., "Dihydrino Molecule Identification", Fusion Technology, Vol. 25, 103 (1994).**

Calorimetry of pulsed current and continuous electrolysis of aqueous potassium carbonate (K^+/K^+ electrocatalytic couple) at a nickel cathode was performed by Thermacore, Inc., Lancaster, PA. The excess power out of 41 watts exceeded the total input power given by the product of the electrolysis voltage and current by a factor greater than 8. Elemental analysis of the electrolyte and metallurgical analysis of the cathode showed no evidence of chemical reactions. The pH, specific gravity, concentration of K_2CO_3, and the elemental analysis of the electrolyte sample taken after 42 days of continuous operation were unchanged from that of the values obtained for the electrolyte sample taken before operation. Elemental analysis and scanning electron microscopy of metallurgical samples of the nickel cathode taken before operation and at day 56 of continuous operation were identical indicating that the nickel cathode had not changed chemically or physically. Scintillation counter and

photographic film measurements showed that no radiation above background was detected indicating that nuclear reactions did not occur.

The "ash" of the exothermic reaction is atoms having electrons of energy below the "ground state" which are predicted to form molecules. The predicted molecules were identified by lack of reactivity with oxygen, by separation from molecular deuterium by cryofiltration, and by mass spectroscopic analysis. The combustion of the gases evolved during the electrolysis of a light water K_2CO_3 electrolyte (K^+/K^+ electrocatalytic couple) with a nickel cathode was incomplete. The mass spectroscopic analysis (Dr. David Parees of Air Products & Chemicals, Inc.) of the m/e = 2 peak of the combusted gas demonstrated that the dihydrino molecule, $H_2(n = 1/2)$, has a higher ionization energy than H_2.

Calorimetry of pulsed current and continuous electrolysis of aqueous potassium carbonate (K^+/K^+ electrocatalytic couple) at a nickel cathode was performed in single cell dewar calorimetry cells by HydroCatalysis Power Corporation. Excess power out exceeded input power by a factor greater than 16. No excess heat was observed when the electrolyte was changed from potassium carbonate to the control sodium carbonate. The faraday efficiency was measured volumetrically to be 100%.

19. **V. Noninski, Fusion Technol., Vol. 21, 163 (1992).**

Dr. Noninski of the Laboratory for Electrochemistry of Renewed Electrode-Solution Interface (LEPGER) successfully reproduced the results of Mills and Kneizys [R. Mills and S. Kneizys, Fusion Technol. Vol. 20, 65 (1991)] as a visiting professor at Franklin and Marshall College. A significant increase in temperature with every watt input, compared with the calibration experiment ($\approx 50\ °C/W$ versus $\approx 30\ °C/W$), was observed during the electrolysis of potassium carbonate. This effect was not observed when sodium carbonate was electrolyzed. No trivial explanation (in terms of chemical reactions, change in heat transfer properties, etc.) of this effect were found.

18. **Niedra, J., Meyers, I., Fralick, G. C., and Baldwin, R., "Replication of the Apparent Excess Heat Effect in a Light Water-Potassium Carbonate-Nickel**

Electrolytic Cell, NASA Technical Memorandum 107167, February, (1996). pp. 1-20.; Niedra, J., Baldwin, R., Meyers, I., NASA Presentation of Light Water Electrolytic Tests, May 15, 1994.

NASA Lewis tested a cell identical to that of Thermacore [Mills, R., Good, W., Shaubach, R., "Dihydrino Molecule Identification", Fusion Technology, Vol. 25, 103 (1994)] with the exception that it was minus the central cathode. A cell identical to the test cell with heater power only (no electrolysis) was the calibration control and the blank cell with the heater power equal to zero. The test cell was also calibrated "on the fly" by measuring the temperature relative to the blank cell at several values of heater input power of the test cell. "Replication of experiments claiming to demonstrate excess heat production in light water-Ni-K_2CO_3 electrolytic cells was found to produce an apparent excess heat of 11 W maximum, for 60 W electrical power into the cell. Power gains ranged from 1.06 to 1.68." The production of excess energy with a power gain of 1.68 would require 0% Faraday efficiency to account for the observed excess power.

17. **Technology Insights, 6540 Lusk Boulevard, Suite C-102, San Diego, CA 92121, "HydroCatalysis Technical Assessment Prepared for PacifiCorp", August 2, 1996.**

This report documents a technical assessment of a novel source of hydrogen energy advanced by HydroCatalysis Power Corporation now BlackLight Power, Inc. (BLP). The assessment was conducted as part of the due diligence performed for PacifiCorp. It was conducted by a literature search and review, site visits to BLP and collaborating organizations, and telephone interviews with others active in the general area. A description of concept is provided in Section 3. Section 4 presents an assessment of the concept background, supporting theory, laboratory prototypes, projected initial products, and economic and environmental aspects. Section 5 documents the results of telephone interviews and site visits. An overall summary and conclusions are presented in the following section.

16. **P. M. Jansson, "HydroCatalysis: A New Energy Paradigm for the 21st Century", Thesis Submitted in partial fulfillment of the requirements of the**

Masters of Science in Engineering Degree in the Graduate Division of Rowan University, May 1997, Thesis Advisors: Dr. J. L. Schmalzel, Dr. T. R. Chandrupatla, and Dr. A. J. Marchese, External Advisors: Dr. J. Phillips, Pennsylvania State University, Dr. R. L. Mills, BlackLight Power, Inc., W. R. Good, BlackLight Power, Inc.

This thesis reviews the problems of worldwide energy supply, describes the current technologies that meet the energy needs of our industrial societies, summarizes the environmental impacts of those fuels and technologies and their increased use by a growing global and increasing technical economy. The work also describes and advances the technology being developed by BlackLight Power, Inc. (BLP) a scientific company located in Princeton, New Jersey. BLP's technology proports to offer commercially viable and useful heat generation via a previously unrecognized natural phenomenon - the catalytic reduction of the hydrogen atom to a lower energy state. Laboratory tests obtained as original research of this thesis as well as the review of the data of others substantiate the fact that replication of the experimental conditions which are favorable to initiating and sustaining the new energy release process will generate controllable, reproducible, sustainable and commercial meaningful heat. For example, Jansson has determined heat production associated with hydrino formation with a Calvet calorimeter which yielded exceptional results. Specifically, the results are completely consistent with Mills hydrino formation hypothesis. Approximately 10^{-3} moles of hydrogen was admitted to a 20 cm^3 Calvet cell containing a heated platinum filament and KNO_3 powder. In the three separate trials with a platinum filament hydrogen dissociator which was varied in length of 10 cm, 20 cm, and 30 cm, a mean power of 0.581, 0.818, and 1.572 watts was observed, respectively. The closed experiments were run to completion. The energy observed was 622, 369, and 747 kJ, respectively, This is equivalent to the generation of $6.2\,X10^8\ J/mole$, $3.7\,X10^8\ J/mole$, and $7.5\,X10^8\ J/mole$ of hydrogen, respectively, as compared to $2.5\,X10^5\ J/mole$ of hydrogen anticipated for standard hydrogen combustion. Thus, the total heats generated appear to be at least 1000 times too large to be explained by conventional chemistry, but the results are completely consistent with Mills model. Convincing

evidence is presented to lead to the conclusion that BLP technology has tremendous potential to achieve commercialization and become an energy paradigm for the next century. The research was also conducted as part of the due diligence performed for Atlantic Energy now Conectiv.

15. **Phillips, J., Smith, J., Kurtz, S., "Report On Calorimetric Investigations Of Gas-Phase Catalyzed Hydrino Formation" Final report for Period October-December 1996", January 1, 1997, A Confidential Report submitted to BlackLight Power, Inc. provided by BlackLight Power, Inc., Great Valley Corporate Center, 41 Great Valley Parkway, Malvern, PA 19355.**

Pennsylvania State University Chemical Engineering Department has determined heat production associated with hydrino formation with a Calvet calorimeter which yielded exceptional results. Specifically, the results are completely consistent with Mills hydrino formation hypothesis. In three separate trials, between 10 and 20 K Joules were generated at a rate of 0.5 Watts, upon admission of approximately 10^{-3} moles of hydrogen to the 20 cm^3 Calvet cell containing a heated platinum filament and KNO_3 powder. This is equivalent to the generation of $10^7\ J/mole$ of hydrogen, as compared to $2.5\,X\,10^5\ J/mole$ of hydrogen anticipated for standard hydrogen combustion. Thus, the total heats generated appear to be 100 times too large to be explained by conventional chemistry, but the results are completely consistent with Mills model.

14. **Phillips, J., Shim, H., "Additional Calorimetric Examples of Anomalous Heat from Physical Mixtures of K/Carbon and Pd/Carbon", January 1, 1996, A Confidential Report submitted to HydroCatalysis Power Corporation provided by HydroCatalysis Power Corporation, Great Valley Corporate Center, 41 Great Valley Parkway, Malvern, PA 19355.**

Pennsylvania State University Chemical Engineering Department has determined excess heat release from flowing hydrogen in the presence of ionic hydrogen spillover catalytic material: 40% by weight potassium nitrate (KNO_3) on graphitic carbon powder with 5% by weight 1%-Pd-on-graphitic carbon (K^+/K^+ electrocatalytic couple) by the very

accurate and reliable method of heat measurement, thermopile conversion of heat into an electrical output signal. Excess power and heat were observed with flowing hydrogen over the catalyst. However, no excess power was observed with flowing helium over the catalyst mixture. Rates of heat production were reproducibly observed which were higher than that expected from the conversion of all the hydrogen entering the cell to water, and the total energy observed was over four times larger than that expected if all the catalytic material in the cell were converted to the lowest energy state by "known" chemical reactions. Thus, "anomalous" heat, heat of a magnitude and duration which could not be explained by conventional chemistry, was reproducibly observed.

13. **Bradford, M. C., Phillips, J., "A Calorimetric Investigation of the Reaction of Hydrogen with Sample PSU #1", September 11, 1994, A Confidential Report submitted to HydroCatalysis Power Corporation provided by HydroCatalysis Power Corporation, Great Valley Corporate Center, 41 Great Valley Parkway, Malvern, PA 19355.**

Pennsylvania State University Chemical Engineering Department has determined excess heat release from flowing hydrogen in the presence of nickel oxide powder containing strontium niobium oxide (Nb^{3+}/Sr^{2+} electrocatalytic couple) by the very accurate and reliable method of heat measurement, thermopile conversion of heat into an electrical output signal. Excess power and heat were observed with flowing hydrogen over the catalyst which increased with increasing flow rate. However, no excess power was observed with flowing helium over the catalyst/nickel oxide mixture or flowing hydrogen over nickel oxide alone. Approximately 10 cc of nickel oxide powder containing strontium niobium oxide immediately produced 0.55 W of steady state output power at 523 K. When the gas was switched from hydrogen to helium, the power immediately dropped. The switch back to hydrogen restored the excess power output which continued to increase until the hydrogen source cylinder emptied at about the 40,000 second time point. With no hydrogen flow the output power fell to zero.

The source of heat is assigned to the electrocatalytic, exothermic reaction whereby the electrons of hydrogen atoms are induced to undergo transitions to

quantized energy levels below the conventional "ground state". These lower energy states correspond to fractional quantum numbers: n = 1/2, 1/3, 1/4, ... Transitions to these lower energy states are stimulated in the presence of pairs of niobium and strontium ions (Nb^{3+}/Sr^{2+} electrocatalytic couple) which provide 27.2 eV energy sinks.

12. **Jacox, M. G., Watts, K. D., "The Search for Excess Heat in the Mills Electrolytic Cell", Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, Idaho, 83415, January 7, 1993.**

Idaho National Engineering Laboratory (INEL) operated a cell identical to that of Thermacore [Mills, R., Good, W., Shaubach, R., "Dihydrino Molecule Identification", Fusion Technology, Vol. 25, 103 (1994)] except that it was minus the central cathode and that the cell was wrapped in a one-inch layer of urethane foam insulation about the cylindrical surface. The cell was operated in a pulsed power mode. A current of 10 amperes was passed through the cell for 0.2 seconds followed by 0.8 seconds of zero current for the current cycle. The cell voltage was about 2.4 volts, for an average input power of 4.8 W. The electrolysis power average was 1.84 W, and the stirrer power was measured to be 0.3 W. Thus, the total average net input power was 2.14 W. The cell was operated at various resistance heater settings, and the temperature difference between the cell and the ambient as well as the heater power were measured. The results of the excess power as a function of cell temperature with the cell operating in the pulsed power mode at 1 Hz with a cell voltage of 2.4 volts, a peak current of 10 amperes, and a duty cycle of 20 % showed that the excess power is temperature dependent for pulsed power operation, and the maximum excess power was 18 W for an input electrolysis joule heating power of 2.14 W. Thus, the ratio of excess power to input electrolysis joule heating power was 850 %. INEL scientists constructed an electrolytic cell comprising a nickel cathode, a platinized titanium anode, and a 0.57 M K_2CO_3 electrolyte. The cell design appears in Appendix 1. The cell was operated in the environmental chamber in the INEL Battery Test Laboratory at constant current, and the heat was removed by forced air convection in two cases. In the first case, the air was circulated by the environmental chamber circulatory system alone. In the second case,

an additional forced air fan was directed onto the cell. The cell was equipped with a water condenser, and the water addition to the cell due to electrolysis losses was measured. The data of the forced convection heat loss calorimetry experiments during the electrolysis of a 0.57 M K_2CO_3 electrolyte with the INEL cell showed that 13 W of excess power was produced. This excess power could not be attributed to recombination of the hydrogen and oxygen as indicated by the equivalence of the calculated and measured water balance.

11. **Peterson, S., H., Evaluation of Heat Production from Light Water Electrolysis Cells of HydroCatalysis Power Corporation, Report from Westinghouse STC, 1310 Beulah Road, Pittsburgh, PA, February 25, 1994.**

Westinghouse Electric Corporation reports that excess heat was observed during the electrolysis of aqueous potassium carbonate (K^+/K^+ electrocatalytic couple) where the electrolysis of aqueous sodium carbonate served as the control. The data of the temperature of the cell minus the ambient temperature shows that when potassium carbonate replaced sodium carbonate in the same cell with the same input electrolysis power, the potassium experiment was twice as hot as the sodium carbonate experiment for the duration of the experiment, one month. The net faraday efficiency of gas evolution was experimentally measured to be unity by weighing the experiment to determine that the expected rate of water consumption was observed. The output power exceeded the total input power. The data was analyzed by HydroCatalysis Power Corporation [Mills, R., Analysis by HydroCatalysis Power Corporation of Westinghouse Report Entitled "Evaluation of Heat Production from Light Water Electrolysis Cells of HydroCatalysis Power Corporation, Report from Westinghouse STC", February 25, 1994].

10. **Haldeman, C. W., Savoye, G. W., Iseler, G. W., Clark, H. R., MIT Lincoln Laboratories Excess Energy Cell Final report ACC Project 174 (3), April 25, 1995.**

During the electrolysis of aqueous potassium carbonate, researchers working at MIT Lincoln Laboratories observed long duration excess power of 1-5 watts with output/input ratios over 10 in some cases with respect to the cell input power reduced by the enthalpy of the generated gas. In these cases, the output was 1.5 to 4 times the integrated volt-ampere power input. Faraday efficiency was measured volumetrically by direct water displacement.

9. **Craw-Ivanco, M. T.; Tremblay, R. P.; Boniface, H. A.; Hilborn, J. W.; "Calorimetry for a Ni/K_2CO_3 Cell", Atomic Energy Canada Limited, Chemical Engineering Branch, Chalk River Laboratories, Chalk River, Ontario, June 1994.**

Atomic Energy Canada Limited, Chalk River Laboratories, report that 128 % and 138% excess heat were observed in separate experiments by flow calorimetry during the electrolysis of aqueous potassium carbonate (K+/K+ electrocatalytic couple) in a closed cell, and that 138% was observed in an open cell.

8. **Shaubach, R. M., Gernert, N. J., "Anomalous Heat From Hydrogen in Contact with Potassium Carbonate", Thermacore Report, March 1994.**

A high temperature/high pressure/high power density industrial prototype gas cell power generator which produced 50 watts of power at 300 °C having a nickel surface area of only 300 cm^2 was successfully developed. A sample of the nickel tubing of the aqueous potassium carbonate permeation cell was analyzed by XPS at the Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA. A broad peak centered at 54.6 eV was present; whereas, the control nickel tube showed no feature. The binding energy (in vacuum) of H(n = 1/2) is 54.4 eV. Thus, the theoretical and measured binding energies for H(n = 1/2) are in excellent agreement. No excess energy or 54.6 eV feature were observed when sodium carbonate replaced potassium carbonate.

7. **Gernert, N., Shaubach, R. M., Mills, R., Good, W., "Nascent Hydrogen: An Energy Source," Final Report prepared by Thermacore, Inc., for the Aero Propulsion and Power Directorate, Wright Laboratory, Air Force Material Command (ASC), Wright-Patterson Air Force Base, Contract Number F33615-93-C-2326, May, (1994).**

In a report prepared for the Aero Propulsion and Power Directorate, Wright Laboratory, Air Force Material Command (ASC), Wright-Patterson Air Force Base, Thermacore reports, "anomalous heat was observed from a reaction of atomic hydrogen in contact with potassium carbonate on a nickel surface. The nickel surface consisted of 500 feet of 0.0625 inch diameter tubing wrapped in a coil. The coil was inserted into a pressure vessel containing a light water solution of potassium carbonate. The tubing and solution were heated to a steady state temperature of 249 °C using an I^2R heater. Hydrogen at 1100 psig was applied to the inside of the tubing. After the application of hydrogen, a 32 °C increase in temperature of the cell was measured which corresponds to 25 watts of heat. Heat production under these conditions is predicted by the theory of Mills where a new species of hydrogen is produced that has a lower energy state than normal hydrogen. ESCA analysis, done independently by Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA, have found the predicted 55 eV signature of this new species of hydrogen."

6. **Wiesmann, H., Brookhaven National Laboratory, Department of Applied Science, Letter to Dr. Walter Polansky of the Department of Energy Regarding Excess Energy Verification at Brookhaven National Laboratory, October 16, 1991.**

Calorimetry of continuous electrolysis of aqueous potassium carbonate (K^+/K^+ electrocatalytic couple) at a nickel cathode was performed in single cell dewar calorimetry cell by Noninski at Brookhaven National Laboratory. Dr. Weismann observed the experiment and reported the results to Dr. Walter Polansky of the U. S. Department of Energy. Dr. Weismann reports, "The claim is as follows. The temperature rise in the dewar is greater in the case of electrolysis as compared to using

a resistor, even though the power dissipated is equal in both cases. According to Dr. Mills' theory, this apparent "excess power" is due to the fact that the electron in a hydrogen atom can "decay" to stable subinterger quantum levels. Dr. Noninski demonstrated this thermal effect at BNL." The observed rise in temperature for a given input power was twice as high comparing electrolysis versus heater power.

5. **Nesterov, S. B., Kryukov, A. P., Moscow Power Engineering Institute Affidavit, February, 26,1993.**

The Moscow Power Engineering Institute experiments showed 0.75 watts of heat output with only 0.3 watts of total power input (power = VI) during the electrolysis of an aqueous potassium carbonate electrolyte with a nickel foil cathode and a platinized titanium anode. Excess power over the total input on the order of 0.45 watts was produced reliably and continuously over a period of three months. Evaluation of the electrolyte after three months of operation showed no significant change in its density or molar concentration. The cell was disassembled and inspected after over one month of operation at 0.1 amperes. This inspection showed no visible signs of a reaction between the electrodes and the electrolyte. The cell was re-assembled and operated as before. Excess energy was produced for the three month duration of the experiment. Scintillation counter measurements showed no signs of radiation external to the cell.

4. **Miller, A., Simmons, G., Lehigh X-Ray Photoelectron Spectroscopy Report, Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University Bethlehem, PA, November 1993.**

Samples of the nickel cathodes of aqueous potassium carbonate electrolytic cells and aqueous sodium carbonate electrolytic cells were analyzed by XPS by Miller and Simmons of the Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA. A broad peak centered at 54.6 eV was present only in the cases of the potassium carbonate cells. The binding energy (in vacuum) of H(n = 1/2) is 54.4 eV. Thus, the theoretical and measured binding energies for H(n = 1/2) are in excellent agreement. Lehigh University has conducted an extensive investigation of the cathodes from heat producing as well as those from control cells. Miller concludes that

"I was unable to find any other elements on the surface that cause the feature. The persistent appearance of a spectral feature near the predicted binding energy for many of the electrodes used with a K electrolyte is an encouraging piece of evidence for the existence of the reduced energy state hydrogen".

3. **Jacox, M. G., Watts, K. D., "INEL XPS Report", Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, Idaho, 83415, November 1993.**

The Lehigh XPS results of a broad peak centered at 54.6 eV present only in the cases of the potassium carbonate cells [Miller, A., Simmons, G., Lehigh X-Ray Photoelectron Spectroscopy Report, Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA, November 1993] were confirmed at Idaho National Engineering Laboratory (INEL). Samples which demonstrated the feature as well as control electrodes were tested for the presence of trace amounts of impurities of the elements iron and lithium at a sensitivity level of greater than 1000 times that of XPS. TOF-SIMS (Time of Flight-Secondary Ion Mass Spectroscopy) and XPS analysis of the nickel surface was performed by Charles Evans & Associates, Sunnyvale, CA [Lee, Jang-Jung, Charles Evans & Associates Time-Of-Flight Secondary Ion Mass Spectroscopy (TOF-SIMS) Surface Analysis Report, CE&A Number 40150, March 18, 1994]. The 54.6 eV feature was also observed by Charles Evans & Associates in the case of cathodes of potassium carbonate electrolytic cells [Craig, A., Y., Charles Evans & Associates XPS/ESCA Results, CE&A Number 44545, November 3, 1994]. Iron and lithium were the only remaining atoms which were in question by Lehigh University and INEL as the source of the 54.6 eV XPS peak. The Charles Evans TOF-SIMS results demonstrate that iron and lithium were not the source of this peak.

2. **Lee, Jang-Jung, Charles Evans & Associates Time-Of-Flight Secondary Ion Mass Spectroscopy (TOF-SIMS) Surface Analysis Report, CE&A Number 40150, March 18, 1994.**

The Lehigh XPS results of a broad peak centered at 54.6 eV present only in the cases of the potassium carbonate cells [Miller, A., Simmons, G., Lehigh X-Ray Photoelectron Spectroscopy Report, Zettlemoyer Center for Surface Studies, Sinclair

Laboratory, Lehigh University, Bethlehem, PA, November 1993] were confirmed at Idaho National Engineering Laboratory (INEL) [Jacox, M. G., Watts, K. D., "INEL XPS Report", Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, Idaho, 83415, November 1993]. Samples which demonstrated the feature as well as control electrodes were tested for the presence of trace amounts of impurities of the elements iron and lithium at a sensitivity level of greater than 1000 times that of XPS. TOF-SIMS (Time of Flight-Secondary Ion Mass Spectroscopy) and XPS analysis of the nickel surface was performed by Charles Evans & Associates, Sunnyvale, CA. The 54.6 eV feature was also observed by Charles Evans & Associates in the case of cathodes of potassium carbonate electrolytic cells [Jacox, M. G., Watts, K. D., "INEL XPS Report", Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, Idaho, 83415, November 1993]. Iron and lithium were the only remaining atoms which were in question by Lehigh University and INEL as the source of the 54.6 eV XPS peak. The Charles Evans TOF-SIMS results demonstrate that iron and lithium were not the source of this peak.

1. **Craig, A., Y., Charles Evans & Associates XPS/ESCA Results, CE&A Number 44545, November 3, 1994.**

The Lehigh XPS results of a broad peak centered at 54.6 eV present only in the cases of the potassium carbonate cells [Miller, A., Simmons, G., Lehigh X-Ray Photoelectron Spectroscopy Report, Zettlemoyer Center for Surface Studies, Sinclair Laboratory, Lehigh University, Bethlehem, PA, November 1993] were confirmed at Idaho National Engineering Laboratory (INEL) [Jacox, M. G., Watts, K. D., "INEL XPS Report", Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, Idaho, 83415, November 1993]. Samples which demonstrated the feature as well as control electrodes were tested for the presence of trace amounts of impurities of the elements iron and lithium at a sensitivity level of greater than 1000 times that of XPS. TOF-SIMS (Time of Flight-Secondary Ion Mass Spectroscopy) and XPS analysis of the nickel surface was performed by Charles Evans & Associates, Sunnyvale, CA [Lee, Jang-Jung, Charles Evans & Associates Time-Of-Flight Secondary Ion Mass Spectroscopy (TOF-SIMS) Surface Analysis Report, CE&A Number 40150, March 18, 1994]. The 54.6 eV feature was also observed by Charles Evans & Associates in the case of

cathodes of potassium carbonate electrolytic cells. Iron and lithium were the only remaining atoms which were in question by Lehigh University and INEL as the source of the 54.6 eV XPS peak. The Charles Evans TOF-SIMS results demonstrate that iron and lithium were not the source of this peak.

Given Applicant's full compliance with the new standards imposed by Specialist McGinty during the February 11, 2003 Interview, which required independent validation of the experimental evidence of record, Applicant is entitled to have this evidence accepted as reliable and to have this and other BlackLight applications issue as patents.

Examiner Langel's Reaffirmation of the Utility and Operability of Applicant's Novel Hydrogen Technology and His Subsequent Resignation From Examining BlackLight Cases "For Moral and Ethical Reasons"

Pursuant to the representations and agreements made during the February 11 Interview (reprinted below), Applicant followed up by submitting much of the independently generated scientific evidence cited above in two pending BlackLight applications and arranging an Interview with Examiner Langel, who was assigned to those cases and supposedly had full authority to issue them. [U.S. Serial Nos. 09/110,678 ('678 application) and 09/362,693 ('693 application).] The express purpose of the Interview, held on April 14, 2003, was to review those two applications on a claim-by-claim basis to ensure that the scientific data presented adequately supported the scope of the claims. Examiner Langel expressed once again his view that the claims of the two applications were adequately supported by the data and, therefore, those claims were allowable.

A detailed account of the discussions Applicant's counsel, Jeffrey Melcher and Jeffrey Simenauer, had with Examiner Langel during the April 14, 2003 Interview, and with Examiner Langel and his supervisor, SPE Stanley Silverman, during follow-up telephone Interviews were documented in Supplemental Responses filed in the '678 and '693 applications, comments from which are reproduced below. Based on the shocking revelations divulged during these discussions, Applicant must once again protest in the strongest terms possible the manner in which an anonymous group of

PTO officials (*i.e.*, the "Secret Committee") has mishandled the examination of BlackLight's patent applications relating to Applicant's novel hydrogen technology.

Counsel was particularly distressed to learn that when Examiner Langel met with Supervisor Silverman to advocate allowing the '678 and '693 applications to issue as patents, his supervisor informed him that "allowance is not an option." Despite the Examiner's careful study of the overwhelming weight of the scientific data supporting allowance, his supervisor further instructed him to "make it appear as if you have authority [to allow the applications] and that you are in favor of full rejection."

Understandably, Examiner Langel felt uneasy having been asked to make representations on the record that were not true. He explained that, "for moral and ethical reasons," he had no choice but to allow himself to be removed from examining all assigned BlackLight applications. Although Supervisor Silverman admitted that the removal decision had been made "partially by [him] and partially by others," he would not reveal who those "others" were.

Applicant strongly objects to Examiner Langel's removal under these egregious circumstances and demands that the PTO reinstate him immediately and allow BlackLight's applications to issue. The Secret Committee is duty bound to honor the representations and agreements made by Quality Assurance Specialist Douglas McGinty during the February 11, 2003 Interview, declaring that:

(1) Examiner Langel and the other Examiners of record have "full authority" to review the scientific data supporting lower energy states of hydrogen generated and furnished by independent third parties and, based on that review, to issue patents as deemed appropriate;

(2) Applicant should confer with the Examiners, either by telephone or in person, to review each assigned application on a claim-by-claim basis to ensure that the scientific data presented adequately supports the scope of the claims; and

(3) for those claims determined to be adequately supported by the data, a patent will issue; for any claims deemed to be inadequately supported, Applicant reserves the right to continue seeking that broader claim coverage in subsequent proceedings. [See March 6, 2003 Response filed in the '678 application.]

It was precisely because of the many prior abuses that led to this short-lived "breakthrough" that U.S. Congressman David Wu sent his Senior Legislative Assistant, Ted Liu, to attend the February 11 Interview. Prior to the Interview, a senior PTO official alleged to Mr. Liu that there was no "Secret Committee." At the Interview, Mr. Liu witnessed not only Specialist McGinty's representation that Examiner Langel had the authority to allow BlackLight's applications, but the Examiner's unequivocal statement that the applications were, in fact, allowable and that he was prepared to issue Applicant his patents right then and there. [See supra and Attachment P]

Despite those representations, an anonymous group of individuals has now declared that allowance is not even an option in BlackLight's cases. Worse yet, this Secret Committee sought to leave the false impression on the record that Examiner Langel—and perhaps other Examiners of record—had the authority to allow BlackLight's applications, and that he favored the rejection of claims over allowance.

In view of this unfortunate incident, which is described in greater detail below, Applicant is entitled to a complete accounting of events leading to Examiner Langel's removal, including identification of all persons involved in making that decision.

Detailed Account of the April 14, 2003 Interview and Subsequent Discussions

As stated above, the express purpose of the April 14, 2003 Interview was to review the scientific data generated and furnished by independent third parties identified in the March 6, 2003 Response that was filed in the '678 and '693 applications in support of the lower energy states of hydrogen and to ensure that the data adequately supported the scope of the claims to secure their allowance.

Applicant had no reason to suspect that this new approach, as agreed to during the prior February 11, 2003 Interview, was about to be completely scrapped. During the subsequent April 14, 2003 Interview, Examiner Langel once again reaffirmed his long-held opinion that the scientific data submitted by Applicant confirmed the operability of his novel hydrogen technology, thus warranting patent protection. The Examiner's comments made clear that, prior to the interview, he had extensively reviewed Applicant's data, as well as the summary statements characterizing that data, appearing in the prior Responses filed in the '678 and '693 applications. Based on that review,

Examiner Langel expressed several times during the Interview his willingness to allow those cases. Those views were confirmed by the Examiner in his interview summary, which stated that "[t]he participants presented data establishing the existence of lower-energy hydrogen." [See April 14, 2003 Interview Summary Form filed in the '678 and '693 applications (Attachment F).]

Examiner Langel, however, refrained from indicating allowance of any specific claims for two stated reasons. First, a few items of submitted data summarized in the March 6 Response inexplicably could not be located in the PTO files. The Examiner wanted time to confirm the data had been made of record, as well as Applicant's description of its relevance. Second, despite Specialist McGinty's representation at the February 11 Interview that Examiner Langel had full authority to review the data and to issue claims in the two interviewed cases, the Examiner explained that he needed to advise him and Supervisor Silverman of his intention to do so.

Examiner Langel then recalled a recent visit to his office by Group Director Jacqueline Stone informing him—again, contrary to what Applicant was told at the February 11, 2003 Interview—that he did <u>not</u> have authority to issue Notices of Allowance, or to otherwise give indications of allowance, in any BlackLight applications. Director Stone instructed Examiner Langel that he would need Specialist McGinty's permission before doing so.

Examiner Langel did, however, note that Supervisor Silverman and Specialist McGinty had agreed before the February 11 Interview to allow claims if Applicant could show that his submitted scientific data was generated by independent third parties. The Examiner reassured counsel that he would present to his superiors the scientific data discussed at the April 14 Interview with a recommendation of allowance consistent with his past views.

Applicant's counsel agreed that it made sense to allow time for Examiner Langel to discuss the case with his superiors and for counsel to resubmit the few missing items of scientific data, whereupon arrangement was made to continue with the personal Interview on the following day, April 15^{th}. That morning, however, counsel received a distressing telephone message from Examiner Langel that the Interview had been

canceled. The Examiner stated that Supervisor Silverman had removed him from the subject cases and that he was no longer assigned to any BlackLight applications.

Applicant's counsel immediately telephoned Examiner Langel for a further explanation of what had happened. The Examiner confirmed his removal following the meeting he had arranged with Supervisor Silverman to discuss the scientific data that had been the subject of the previous day's Interview and to advocate allowance of the claims in the two subject applications. Examiner Langel informed counsel that his supervisor refused to even look at the data and, in response to his recommendation of allowance, Supervisor Silverman told him "allowance is not an option." According to Examiner Langel he was then told: "Make it appear as if you have authority [to allow the applications] and that you are in favor of full rejection."

Examiner Langel explained that, regrettably, he had no choice but to resign from further examination of BlackLight's applications. According to the Examiner, Supervisor Silverman gave him the option of staying on, "but not really—I could not go on like this." He explained that "for moral and ethical reasons," he could no longer continue to examine his assigned cases.

Alarmed by this sudden turn of events, counsel called Supervisor Silverman the following day, April 16th, to protest Examiner Langel's removal and to seek his reinstatement. Supervisor Silverman confirmed that Examiner Langel would no longer be examining Blacklight's patent applications and that all of its cases were in the process of being consolidated and transferred to a new Examiner.

Counsel kindly requested that Supervisor Silverman explain why those cases were being transferred and who made that decision. He initially refused to discuss the matter, saying only that, "I am not going to be put on the stand and cross examined on this." Upon further prodding, Supervisor Silverman volunteered that "the decision was made partially by me and partially by others." He refused, however, to be more specific when asked to identify the "others" involved in the decision, stating "I am not going to discuss that. You can say that it was *my* decision."

Counsel then informed Supervisor Silverman of Applicant's intention to file an objection to Examiner Langel's removal and to the consolidation and transfer of BlackLight's applications to a new Examiner. Counsel explained that Applicant had

expended enormous amounts of time and money over a period of many years prosecuting BlackLight's patent applications before Examiner Langel and getting him up to speed on the claimed technology and the extensive scientific data confirming its operation. Counsel argued that it was unfair to remove Examiner Langel and transfer all of BlackLight's cases to a new Examiner just to begin the process all over again. Supervisor Silverman would hear none of it, again stating, "I'm not going to discuss it."

Applicant's counsel made one last attempt to learn the identity of the other PTO officials responsible for taking this drastic action and their reasons for doing so. Supervisor Silverman again refused this request for information, snapping at counsel, "You figure it out!" Counsel then asked the Supervisor whom they might talk to so they could "figure it out" as he had put it. Supervisor Silverman advised counsel, "Talk to whomever you want," but when asked whom specifically he had in mind, he again retorted, "I don't like to be cross-examined."[116]

At the end of the conversation, Supervisor Silverman attempted to justify the PTO's extreme actions by claiming that it was in the "best interest" to transfer the applications. But, when asked by counsel whose best interest was being served by the transfer, he refused to answer. Supervisor Silverman, however, did offer the stunning revelation that Applicant's novel hydrogen technology was "beyond Examiner Langel's technical expertise" and that all of BlackLight's cases would be consolidated and transferred to another examiner with "more technical expertise." He would not elaborate on who this new, more highly qualified Examiner might be.[117]

Needless to say, at no time during the five years Applicant had been prosecuting his patent applications before Examiner Langel—who has over thirty years of Patent Office experience—did his technical expertise ever come into question. Indeed,

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[116] Counsel has taken steps "to figure it out" and expressly reserves the right to further supplement the objections raised herein as additional facts come to light. (Attachment R)

[117] All of BlackLight's applications have now been consolidated under the direction of a newly identified Examiner, Dr. Bernard Eng-Kie Souw, whose views have been adopted by the Committee in rejecting Applicant's cases in the name of four Examiners: Examiners Kalafut, Tsang-Foster, Wells, and Tanner. Applicant notes, however, that Dr. Souw is far less experienced in patent matters than his predecessor, Examiner Langel. Furthermore, as discussed in detail below, Dr. Souw's views are not only technically inaccurate, but are also tainted due tho a genuine conflict of interest based on his involvement in questionable outside business activities while examining Applicant's cases.

throughout the lengthy prosecution of these cases, counsel has been impressed with the Examiner's in-depth knowledge of chemistry and physics, as well as other scientific principles, underlying Applicant's technology. That Supervisor Silverman would raise Examiner Langel's technical competence as an issue at such a late stage of that prosecution only heightens Applicant's suspicions as to the real motivation for removing Examiner Langel.

Immediately following the conversation with Supervisor Silverman, counsel telephoned Examiner Langel one last time to apprise him of the situation and to thank him for his many years of service in examining BlackLight's applications. Examiner Langel expressed regret over his removal from those cases and confirmed that he had "learned a lot about [BlackLight's] technology." The Examiner also expressed surprise that his expertise was now being called into question.

Examiner Langel shared counsel's exasperation over the situation. Counsel asked him if he knew of any other instances in which a PTO Examiner had been instructed to represent that he had authority to allow an application when, in fact, he had no such authority, and that he favored rejecting claims when he actually wanted to allow them. The Examiner's exact words were: "I've never seen anything like it."

Frankly, neither has Applicant's counsel and, in view of these unique circumstances, Applicant must once again strenuously object to the abusive treatment to which his applications have been subjected.

The Secret Committee Has Demonstrated Extreme Bias In Its Handling of BlackLight's Patent Applications Due to Genuine Conflicts of Interest

Following Examiner Langel's unfortunate resignation from examining BlackLight's applications, the Committee consolidated those cases under a new, supposedly more experienced Examiner. Consequently, the Committee's rejections of Applicant's claims in this and other pending BlackLight applications based on inoperability due to the alleged non-existence of lower-energy hydrogen now rely heavily, if not almost exclusively, on the views expressed by that new Examiner, Dr. Bernard Eng-Kie Souw. Indeed, Dr. Souw is known to have prepared on behalf of the Committee over one

hundred pages of arguments, which in one form or another, have now found their way into all of BlackLight's cases in support of the Committee's rejections.

As explained in more detail below, Dr. Souw's involvement in shaping the Committee's views in this case raises serious questions regarding the biased nature of those views due to his genuine conflicts of interest. In fact, Dr. Souw's biased views have so tainted the present rejections that the Committee must withdraw those rejections and allow the pending claims to issue.

The Committee's Refusal To Disclose the Details of Dr. Souw's Employment History Raises Serious Questions Of Whether It Is Capable Of Fairly Examining Applicant's Cases

The Committee's appointment of Dr. Souw came at a critical juncture in the examination of Applicant's pending cases. As explained above, in April 2003, Examiner Langel, one of the two original examiners assigned to these cases, had resigned from his examining duties "for moral and ethical reasons." Examiner Langel's abrupt resignation came after being instructed to misrepresent that he favored denying Applicant his patents when the record showed he wanted to allow those patents to issue, and that he had authority to grant such allowance when, in fact, he was told that "allowance is not an option."

To justify Examiner Langel's resignation after the fact, the PTO informed Applicant that his cases were being transferred and consolidated under the direction of an Examiner with "more technical experience." A few short weeks later, Dr. Souw began making appearances in Applicant's cases even though he had only a few years of experience as an Associate Examiner, as compared to Primary Examiner Langel, who had over thirty years of PTO examining experience. [See Appendix attached to the Committee's May 7, 2003 Office Action issued in U.S. App'n Ser. No. 09/513,768 ('768 application).] Examiner Langel also demonstrated a far superior technical understanding of Applicant's technology judging by the far superior arguments found throughout Dr. Souw's Appendices.

Applicant was naturally suspicious of Dr. Souw's prominent membership on the Committee given the prosecution history of BlackLight's pending applications already

discussed. As further detailed below, this new appointment prompted Applicant to raise initial questions regarding Dr. Souw's employment history after he first showed bias in examining these cases by citing his own technical papers against Applicant. Rather than answer those questions, the Committee stonewalled once again, defensively arguing that:

> [T]he employment history of examiners, including those acting in a consulting role, is irrelevant to the examination thereof, except where there is a genuine conflict of interest. [See 4/14/04 Office Action in U.S. App'n Ser. No. 09/008,947 at p. 5.]

Dr. Souw has been similarly uncooperative, although he did provide some limited information regarding his employment history by citing to his background in microwave plasmas:

> Since the cited Examiner's papers cannot possibly have been criticized by Applicant, citing his own publication(s) does not make the Examiner's view "biased", as alleged by Applicant. In the contrary, such technical papers provide a solid evidence that the Examiner is in possession of sufficient background for evaluating Applicant's claimed invention. In this regard, the Examiner can add a further evidence of strong background in microwave plasmas generated in a resonance cavity similar to those used by Applicant, not only in theory, but also hands-on in its design, construction and routine operation, as well as in its spectroscopy, both low and high resolutions [1]. [Souw Appendix at p. 4 attached to the March 29, 2004 Office Action filed in the '768 application.]

The reference [1] cited by the Examiner as evidence of his supposed "strong background in microwave plasmas" is an article published in March 1987: Souw, Eng-Kie, Plasma density measurement in an imperfect microwave cavity, J. Appl. Phys. 61 (5), 1 March 1987.[118]

The Committee's defensive remarks regarding the irrelevancy of Dr. Souw's employment history, when contrasted with the Examiner's own remarks extolling the relevancy of that history, are truly astounding. The Committee's statements are even

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[118] Ironically, Dr. Souw attempts to establish his credibility in evaluating Applicant's novel hydrogen technology by citing his peer-reviewed article published in the *Journal of Applied Physics*, yet argues that Applicant's article published in that very same journal does not establish similar credibility. In taking those contradictory positions, the Committee reveals yet another double standard that only reinforces its bias against Applicant.

more remarkable, however, when considered in the context of additional information that has come to Applicant's attention concerning Dr. Souw's engagement in questionable business activities that began before, and continued after, all of BlackLight's pending applications were consolidated and assigned to Dr. Souw.

This information came to light only after Applicant, unable to get straight answers from the Committee regarding Dr. Souw's background, undertook his own investigation into the Examiner's employment history. That investigation uncovered a much more recent 2003 article authored by Dr. Souw, in which he admits that he worked as the lead scientist for a consulting company that he co-founded, BMS Enterprise (BMS) in Herndon, Virginia, at the same time he worked for the PTO examining BlackLight's applications. Dr. Souw also admits in the article that his business activities for BMS includes work in at least two technical areas, which are identical to, and therefore compete with, those practiced by BlackLight.[119] Given that one of those technical areas is microwave plasmas, it is highly suspicious that the Committee and Dr. Souw withheld this highly relevant, up-to-date work experience in support of his supposedly "strong background in microwave plasmas," citing instead an outdated, 17-year-old article in support. The reason the Committee and Dr. Souw withheld this important information is obvious: if correct—and Applicant has no reason to doubt this given that the source is Dr. Souw himself—there would appear to be multiple violations of the PTO's own ethics rules. At the very least, the ability of the Committee under the direction of Dr. Souw to fairly evaluate the merits of Applicant's novel hydrogen technology has once again been called into serious question.

The above-mentioned article was published in *Optical Engineering* on November 2, 2003. [Souw, Bernard Eng-Kie, Coherent telescope array with self-homodyne interferometric detection for optical communications, Opt. Eng. 42(1) 3139-3157 (November 2003) (Tab S).] As the author of that article, Dr. Souw's name prominently appears on first page (p. 3139), identifying his association with BMS as follows:

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[119] Incredibly, since the time Applicant first brought this information to the PTO's attention in his October 14, 2004 Response filed in U.S. Patent App'n Ser. No. 09/008,947, and subsequently in other pending cases, not only has the PTO failed to seriously address the issues raised, but it continues to cite and rely on Dr. Souw's biased arguments. These actions leave Applicant no choice but to seek other avenues for relief from this unfair treatment.

Bernard Eng-Kie Souw
BMS Enterprise
P.O. Box 5524
Herndon, Virginia 20172-5524
E-mail: souw1@juno.com

The last page of the article (p. 3157) is particularly informative as it summarizes Dr. Souw's technical background and work experience establishing his connection to BMS as its co-founder and lead scientist. Applicant reproduces the following relevant portions of that background summary, which notably describes BMS as providing consulting services in two main technical areas, microwave plasma devices and CVD diamond synthesis and applications, that are identical with those practiced by BlackLight:

> In 1985, [Bernard Eng-Kie Souw] joined Brookhaven National Laboratory (BNL) in Long Island, New York as staff member in a Star Wars project. He was awarded a Department of Energy research grant in 1993 and became Principal Investigator in a research and development project on a novel, solar blind and fieldable alpha-beta-gamma radiation detector in collaboration with Northrop-Grumman and New Jersey Institute of Technology. **About the same time he cofounded BMS Enterprise, a multi-interdisciplinary consulting company providing services mainly in microwave plasma devices and CVD diamond synthesis and applications. He left BNL in 1997 and became a patent examiner with the US Patent and Trademark Office in Arlington, Virginia until 2000, when he joined ITT Industries in Reston, Virginia as a scientist and engineering specialist in optical communications. He left ITT in 2002 to dedicate more time as lead scientist with BMS Enterprise.** [Emphasis added.]

As the Committee is no doubt aware, Applicant's novel hydrogen technology has many potential commercial applications, including the aforementioned microwave plasma devices and CVD diamond synthesis. Indeed, Applicant presently has on file two copending applications directed to these specific art areas. [See U.S. App'n Ser. No. 10/469,913, filed March 7, 2002; and PCT/US/13412, filed May 1, 2002.] Applicant has serious concerns that these and other competitive technologies that BMS and BlackLight engage in may have affected, and will continue to affect, the manner in which the Committee has examined and rejected his applications.

This situation is particularly disturbing in light of PTO ethics rules that prohibit patent examiners from engaging in outside business activities that conflict with their assigned administrative duties. [See *Summary of Ethics Rules* for the U.S. Patent and Trademark Office published by the U.S. Department of Commerce, Office of the General Counsel, Ethics Division (2000) (Tab S)] As the introductory paragraph to these ethical rules makes clear, the issue involved here is one of public trust:

> **PUBLIC SERVICE IS A PUBLIC TRUST**
>
> As an employee of the U.S. Patent and Trademark Office you have been placed in a position of trust and are held to a high standard of ethical conduct. This handout contains a summary of the rules set forth in conflict of interest statutes and the *Standards of Ethical Conduct for Employees of the Executive Branch.* [Ethics Rules at p. 1 (Tab S)]

To hold examiners to this high standard of ethical conduct, the rules prohibit activities that would create a financial conflict of interest:

> **Financial Conflicts of Interest.** You may not, as part of your official Government duties, participate in any matter that will have a direct and predictable effect on your personal financial interest, unless an exemption applies. This rule applies to matters involving specific parties in which you have a financial interest and to broad policy matters that affect many entities, including ones in which you have an interest (such as a policy affecting an entire industry sector if you have stock holdings in one of the companies in the industry sector). [Ethics Rules at p. 2 (Tab S) (emphasis in original).]

Other PTO ethic rules govern outside employment activities:

> **General Rule on Outside Activities.** You may not engage in outside employment or any other personal activity that conflicts with your Department position, including employment that requires disqualification from a significant part of your Government duties or an activity that creates an appearance of using your public office for private gain. You must disqualify yourself from participating in a matter as a Department employee which may affect the financial interests of an outside employer or in which an outside employer, or an organization in which you are an active participant, is a party or is representing a party. . . . [Ethics Rules at p. 5 (Tab S) (emphasis in original).]

These restrictions against financial conflicts of interest and outside employment activities are further amplified with specific reference to patent examiners in the following rules:

> **Financial conflicts of Interest**
>
> Conflicts of Interests regarding Patent Examiners If you are a patent examiner, you may not participate in the review of any patent if you have a financial interest in a company that may be affected by the issuance or denial of the patent (unless your interest is in publicly-traded stock valued at $5,000 or less in all affected companies). . . . [Ethics Rules at p. 10 (Tab S)]
>
> **Outside Employment and Activities**
>
> Service with Non-Federal organizations If you serve as an officer or director of an outside organization, such as a professional association, you may not participate as a USPTO employee on any matter that is likely to affect the financial interests of the organization. This may preclude you from serving with organizations that are active in matters before your office. If it would benefit USPTO to have an official relationship with a private organization, you may be assigned as a liaison to the organization, in which case your service with the organization would be in an official capacity, rather than as an outside activity. However, you may not be assigned to service in an official capacity as an officer or director of a non-Federal organization (other than a standards-setting body). [Ethics Rules at p. 11-12 (Tab S) (emphasis in original).]

The applicability of these ethics rules to the present situation cannot be seriously disputed. Dr. Souw was employed as a PTO Examiner at the same time he admits to working as the lead scientist for BMS with an apparent ownership stake in the company, which has a competing interest with BlackLight. Indeed, records indicate that Dr. Souw was a PTO employee prior to the date *Optical Engineering* first received his BMS article on February 6, 2003, and throughout the time that paper was being revised and received on May 6, 2003, and ultimately published on November 2, 2003.[120]

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[120] See, for example, U.S. Patent No. 6,506,648, issued January 14, 2003, which identifies Bernard Souw as the Assistant Examiner. Based on established PTO procedures, Examiner Souw is believed to have been a PTO employee when the Notice of Allowance was issued in that case, well before January 2003.

The article's May 6, 2003 revision date is particularly significant. It was only <u>one</u> day later, on May 7, 2003, that the Committee began issuing rejections in BlackLight's pending cases based on Appendices authored by Dr. Souw, starting with the '768 application. Dr. Souw's genuine conflict of interest in working for BMS during his employ as a PTO examiner—and while rejecting a competitor's patent applications no less—should be obvious to any fair-minded person and, thus, requires no further discussion.[121]

This clear conflict of interest is especially troubling given the many other questionable activities that have occurred in the prosecution of BlackLight's applications as documented and described above, including:

(1) the withdrawal from issue of five allowed BlackLight applications under highly suspicious circumstances involving interference by Dr. Robert Park, spokesman for the American Physical Society (APS), a BlackLight competitor;

(2) the admission by Dr. Park's APS colleague, Dr. Peter Zimmerman, that Dr. Park has a "Deep Throat" contact at the Patent Office who has provided him with information concerning BlackLight applications;

(3) the rejection of Applicant's claims based on a non-peer reviewed article posted on an Internet bulletin board authored by Dr.

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[121] Interestingly, Dr. Souw mentions in his article that he co-founded BMS in 1993 while working for BNL and that he left BNL in 1997 to join the PTO, apparently while still operating BMS. According to the article, Dr. Souw then left the PTO in 2000 to join ITT Industries as a scientist/engineer in the optical communications field until 2002, when he left "to dedicate <u>more</u> time as lead scientist with BMS Enterprise." [Emphasis added.] Dr. Souw, however, notably fails to mention in the BMS article his apparent re-employment by the PTO, which failure, incidentally, <u>does</u> comply with at least one PTO ethics rule: "you <u>may not</u> use your Government title in connection with a non-Government activity." [[Ethics Rules at p. 7 (Tab S) (emphasis in original)]

Also somewhat troubling is that Dr. Souw apparently continues to examine and issue applications in other art areas that overlap with his scientific work for BMS, including optical communications, which is the subject matter of his published article. [See, e.g., U.S. Patent No. 6,801,676, filed June 24, 2003 and issued October 5, 2004, on a "Method and apparatus for phase shifting an optical beam in an optical device with a buffer plug" (recognizing in the "Background of the Invention" section that "the need for fast and efficient optical-based technologies is increasing as Internet data traffic growth rate is overtaking voice traffic pushing the need for optical communications.")]

Zimmerman, who has bragged that while working at the State Department his agency and the Patent Office "have fought back with success" against BlackLight;

(4) Dr. Zimmerman's improper contact of scientific journals in an attempt to prevent Applicant from meeting the publication requirement imposed by the Committee before his experimental evidence would even be considered; and

(5) Examiner Wayne Langel's untimely resignation from the examination of BlackLight's applications for "moral and ethical reasons" after being told to materially misrepresent the record and that "allowance is not an option" in these cases.

In view of this sordid prosecution history, Applicant is understandably outraged by the discovery that following Examiner Langel's unfortunate resignation, the Committee appointed Dr. Souw to continue carrying out its "allowance is not an option" policy while he represented a competing interest. Applicant has demanded several times that the PTO provide a complete accounting of the facts and circumstances surrounding prior questionable activities, including those summarized above. Applicant has made a similar demand for information in connection with this latest episode involving Dr. Souw's conflicted association with BMS Enterprise while assigned to examine and reject BlackLight's pending patent applications. Applicant now repeats that demand for information here, including but not limited to a full disclosure of the facts and circumstances relating to:

(1) Dr. Souw's appointment as an examiner assigned to review BlackLight's pending patent applications;

(2) his outside business activities with BMS Enterprise, and with any other business ventures in which he has a financial interest;

(3) his contact with any sources outside the PTO with regard to the subject matter disclosed in any of BlackLight's applications; and

(4) his membership activities, or any other participation, in any professional organizations, including the APS.[122]

Unfortunately, like Applicant's many other information requests, this one too has been ignored by the Committee despite the serious implications of Dr. Souw's genuine conflict involving his outside business activities. The Committee's refusal to honor these requests, however, only raise further suspicions that there is more information that would only strengthen Applicant's case for a genuine conflict of interest.

Instead of being forthcoming with the true facts and circumstances surrounding that conflict, the Committee initially tried to obscure it by advancing irrelevant and factually inaccurate arguments that contradicted Dr. Souw's own admissions:

> Applicant's remarks concerning examiner Souw, and the article (Attachment S) are noted. This article deals with a telescope array, and does not appear to show any conflict of interest between Dr. Souw's <u>former</u> employer, BMS Enterprise, and his consulting involvement with the present application. [See, e.g., December 21, 2004 Advisory Action filed in U.S. App'n Ser. No. 09/362,693 at p. 2 (emphasis added.)]

The Committee's carefully crafted denial of Dr. Souw's obvious genuine conflict of interest only raised further suspicions by its failure to even address Applicant's basis for asserting the conflict. While the Committee claims to have noted Applicant's remarks regarding this issue, it is apparent from its initial brief response that, true to form, those remarks were wholly ignored.

The Committee's refusal to seriously address the conflict in this case is clear from its narrow focus on the subject matter of the Souw article. Although the Committee

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[122] This information is deemed relevant to the following additional PTO ethics rule:

> **Appearances of Bias (non-Financial Conflicts of Interest)**
>
> <u>Participation in Professional Organizations</u> If you are an active member of a professional organization, such as a member of a[n] association of attorneys or patent professionals, you will be barred from participating in USPTO on matters in which that organization is a party or is representing a party. If this will interfere with your USPTO duties, you should refrain from such activities or should seek advice from the Ethics Division. . . . [PTO Ethics Rules at p. 10 (Tab S)]

As explained in detail above, and in previous Responses, Applicant has good reason to believe that the APS, and perhaps other professional organizations, have become involved as active participants in these proceedings.

correctly notes that the article "deals with a telescope array," that fact is totally irrelevant and, thus, cannot possibly support the Committee's conclusion that the article "does not appear to show any conflict of interest." [Emphasis added.]

Applicant has never relied on the subject matter of Dr. Souw's article as a basis for establishing a conflict in the present application. Rather, as previously discussed, that showing is based upon Dr. Souw's admission in the background summary of the article that he co-founded BMS Enterprise and has continued to operate the company as its lead scientist.[123] In that capacity, he works in two main technical areas—microwave plasma devices and CVD diamond synthesis and applications—identical to those practiced by Applicant while also employed by the PTO to examine and reject Applicant's cases. The Committee's initial refusal to even acknowledge that aspect of Applicant's showing of a genuine conflict of interest in this case, much less discuss it, is telling and only confirms Applicant's showing that a conflict does indeed exist.

The Committee further confirms this conflict in its attempt to gloss over Dr. Souw's startling admission that he operates a business enterprise that competes with Applicant's business interests while examining his cases by claiming that the subject matter of the article, i.e., a telescope array, does not establish a conflict of interest "between Dr. Souw's former employer, BMS Enterprise, and his consulting involvement with the present application." [Emphasis added.] Aside from being non-responsive, this argument is also factually inaccurate.

The Committee incorrectly refers to BMS as a "former employer," in contradiction to Dr. Souw's admissions that he co-founded BMS and, therefore, is presumably a principal owner of the company, and that he continued to operate the company after he was employed by the PTO as an Examiner. The Committee merely compounded its error based on the alleged "former employer" status of BMS with the unfounded conclusion that no conflict of interest exists between Dr. Souw's work for BMS as its lead scientist and his work for the PTO as the Examiner primarily responsible for

[123] As footnoted above, Applicant's only reference to a conflict involving the subject matter of Dr. Souw's article, i.e. optical communications, revolves around his continued examination of other patent applicants' cases in that same art. This pattern of ignoring conflicts merely provides further support for, but does not form the basis of, Applicant's clear showing that Dr. Souw is also conflicted in this case based on his ongoing work for BMS, as disclosed in the article's background summary.

examining and rejecting Applicant's cases. In drawing this erroneous conclusion, the Committee all but admits the obvious—that Dr. Souw's current employment with BMS does in fact create a genuine conflict of interest, which then taints the Committee's rejections in all of Applicant's cases.

Perhaps realizing the incoherence of its initial response regarding the issue of Dr. Souw's apparent conflict of interest, the Committee, in a subsequent response, drastically changed its position. Although the Committee no longer tries to mischaracterize BMS as a "former employer," astonishingly, it now argues that Dr. Souw's continued operation of that company while he examined and rejected Applicant's patent applications does not create a conflict:

> Applicant also implies (page 108) that Dr. Bernard Souw, who has been consulted during the examination of his applications, is also involved in work "competitive" to this [sic] own, which would produce a conflict of interest. The evidence offered by applicant, an article written by Dr. Souw, deals with a telescope array, which is neither an alternative form of hydrogen nor a new previously unappreciated source of energy, and thus does not appear to be competitive with the present "hydrino" or any battery based thereon. While the biographical sketch at the end of the article mentions his involvement in consulting work having to do with microwave plasma devices and CVD diamond synthesis, this would not amount to competition with the present invention or the underlying hydrinos. Diamonds are a form of carbon, and thus are not in competition with hydrogen. Microwave plasma devices are not necessarily related to hydrogen, since they are a type of device or machine. [2/11/05 Office Action at page 4 filed in U.S. App'n Ser. No. 09/110,717.]

The Committee's latest arguments regarding Dr. Souw's conflicting business activities are no more convincing than those previously posited and, in fact, raise so many new issues, Applicant hardly knows where to begin. First, Applicant did not "imply" anything; rather, he simply quoted relevant portions of Dr. Souw's own article admitting to outside business activities that clearly conflict with technologies practiced by Applicant whose pending patent applications has examined and rejected. That alone is sufficient to establish a genuine conflict of interest that fatally taints the biased views of Dr. Souw, which have been universally adopted by the Committee.

Second, the Committee's comment regarding "the evidence offered by Applicant" is disturbing. It is not Applicant's responsibility to "offer" evidence that the Committee

itself should have produced in the first place. Worse yet, the Committee continues to withhold additional evidence responsive to Applicant's reasonable request for background information relevant to Dr. Souw's employment history and any conflicts and biases he may have. If and when the Committee decides to cooperate in supplying the requested information, there no telling what additional genuine conflicts of interest will arise in this case based on "the evidence offered by Applicant."

Third, as previously discussed, the Committee's reliance on the subject matter of the article, i.e., a telescope array, is a "red herring" that has absolutely nothing to do with the conflict issues surrounding Dr. Souw's questionable business activities. Applicant has never once asserted that Dr. Souw's work in the area of telescope arrays creates a genuine conflict of interest in this case. For the Committee to raise this as an issue merely highlights the desperation of its latest arguments, further exposing the weakness of its position.

Fourth, the Committee uses strained reasoning in asserting that Dr. Souw's admission to his involvement in consulting work relating to microwave plasma devices and CVD diamond synthesis "would not amount to competition with the present invention or the underlying hydrinos." As explained above, and in other numerous responses, one direct application of the BlackLight's lower-energy hydrogen technology is CVD diamond synthesis, which subject is covered by claims in one of its pending patent applications. For the Committee to ignore this plain, simple fact and weakly argue instead that "[d]iamonds are a form of carbon, and thus are not in competition with hydrogen" merely demonstrates its refusal to take the conflict issue seriously. Similarly, the Committee's excuse that "microwave plasma devices are not <u>necessarily</u> related to hydrogen, since they are a type of device or machine" hardly merits a response. Again, the formation of microwave plasmas is a direct application of BlackLight's lower-energy hydrogen technology as Dr. Souw himself has recognized, and is covered in its pending patent applications. Dr. Souw has recognized as much admitting that his work for BMS provides further evidence of his "strong background in microwave plasmas generated in a resonance cavity similar to those used by Applicant." [See, for example, Souw Appendix at p. 4 attached to the March 29, 2004 Office Action filed in U.S. App'n Ser. No 09/513,768.]

Fifth and finally, the PTO members of the Committee know better than anyone that direct competition between the Examiner and the Applicant whose case he is examining is not the proper standard used in determining the presence of a conflict of interest. Indeed, the PTO's own Ethics Rules, as discussed above, forbid an Examiner from engaging in outside employment activities that create even the appearance of impropriety:

> **General Rule on Outside Activities.** You may not engage in outside employment or any other personal activity that conflicts with your Department position, including employment that requires disqualification from a significant part of your Government duties or an activity that creates an appearance of using your public office for private gain. . . . [Ethics Rules at p. 5 (Tab S) (emphasis in original).]

Incredibly, after initially withholding information about Dr. Souw's outside business interests, and then trying to pass him off as a former BMS employee, the Committee once again contradicts its own prior statements in a subsequent Office Action begrudgingly admitting that Dr. Souw, in fact, owns the company and, therefore, "may appear to have a conflict of interest." In making that admission, however, the Committee blatantly disregards the PTO's own Ethics Rules in contending that this appearance of impropriety does not prevent Dr. Souw from examining Applicant's patent cases based on the absurd argument that he does not work on fuel cells in direct competition with Applicant:

> Applicant argues . . . that examiner Bernard Souw owns a company which provides consulting services in two technical areas, microwave plasma devices and CVD diamond synthesis. While an examiner with such outside employment may appear to have a conflict of interest, such a conflict can be avoided if he refrains from either working on applications dealing with these, or working on these things in his outside employment. The present application, however, is drawn to a fuel cell, which is outside those fields, and thus would not be in competition with any consultation therein. [Final Office Action dated July 18, 2005 issued in U.S. App'n Ser. No. 09/008,947.]

Like the Committee's previous attempts to cover up Dr. Souw's obvious conflict of interest, this one too must fail. Simply put, the presence or absence of direct

competition is not the standard by which conflict of interest issues are to be judged. As noted above, the admitted appearance of a conflict is alone sufficient to disqualify Dr. Souw as an examiner in this case and exclude his biased arguments.

In any case, the Committee admits by its own arguments that Dr. Souw's work on microwave plasma devices and CVD diamond synthesis overlaps with Applicant's business interests and, therefore, denying Applicant his patents, including one in this case, works to Dr. Souw's economic benefit. Contrary to the Committee's misguided view of the rules on ethics, such a conflict is not avoided by Dr. Souw's alleged non-competition in the narrowly drawn field of fuel cells.

Applicant suspects that the Committee's latest self-serving statements are narrowly confined to avoid disclosing the full scope of Dr. Souw's outside business activities, which information Applicant has repeatedly requested for years without the courtesy of a response. Rather, the Committee incorrectly assumes, without basis, that Dr. Souw's outside business activities are limited to his work on microwave plasma devices and CVD diamond synthesis. Applicant knows for a fact, however, that these are not the only two technical fields in which Dr. Souw is engaged in, as he himself admits in the background section of the journal article unearthed by Applicant's counsel:

> [Dr. Souw] cofounded BMS Enterprise, a multi-/interdisciplinary consulting company providing services mainly [i.e., not exclusively] in microwave plasma devices and CVD diamond synthesis and applications. [Souw, Bernard Eng-Kie, Coherent telescope array with self-homodyne interferometric detection for optical communications, Opt. Eng. 42(1) at 3157 (November 2003) (Tab S) (emphasis and explanatory note in brackets added).]

That statement makes clear that there are other technical fields Dr. Souw engages in through his work for BMS. The Committee's refusal to provide Applicant with this important relevant information only fuels suspicion that there are other conflicting technologies, either through BMS or perhaps other outside endeavors, that have not yet been revealed.

Applicant is particularly suspicious of the Committee's carefully worded statements regarding Dr. Souw's work in the fields of microwave plasmas and CVD

diamond synthesis and that Applicant's '947 application is "drawn to a fuel cell, which is outside those fields, and thus would not be in competition with any consultation therein." That statement is not an affirmative declaration that Dr. Souw has refrained from working in other technical fields that may also be common to those applications he has examined or otherwise provided input.[124]

The Committee's tenuous arguments in this regard are also shot down by Dr. Souw himself through his own incriminating statements. For example, before counsel's independent investigation uncovered Dr. Souw's conflicting business activities for BMS, Dr. Souw proudly touted his supposed "strong background in microwave plasmas." According to Dr. Souw, this information was highly relevant to his qualifications for examining the subject matter of Applicant's pending cases:

> In the contrary, such technical papers provide a solid evidence that the Examiner is in possession of sufficient background for evaluating Applicant's claimed invention. In this regard, the Examiner can add a further evidence of strong background in microwave plasmas generated in a resonance cavity similar to those used by Applicant, not only in theory, but also hands-on in its design, construction and routine operation, as well as in its spectroscopy, both low and high resolutions [1]. [Souw Appendix at p. 4 attached to the March 29, 2004 Office Action filed in the '768 application.]

By Dr. Souw's own admission, his work for BMS also provides further evidence of his "strong background in microwave plasmas generated in a resonance cavity similar to those used by Applicant" and, thus, clearly raises a genuine conflict of interest. For the Committee to limit discussion of the relevant subject matter of Applicant's cases to "fuel cells," or any other technological field supposedly outside the scope of Dr. Souw's business activities—such as plasmas, for example—is simply nonsensical.

Of course, once the Committee comes clean with a full disclosure of all of Dr. Souw's outside business activities, other conflicts may also emerge and Applicant anxiously awaits that information. In the meantime, the Committee only adds to the injustice perpetrated against Applicant by maintaining the rejections of record as it continues citing Dr. Souw's

[124] Of course, once a conflict of interest has been established in even one of Applicant's cases, that is a sufficient showing that Dr. Souw's bias has infected all of Applicant's cases in which his views appear.

biased views against Applicant.[125] Applicant once again strenuously protests this unfair treatment and demands that the rejections in the present application be withdrawn immediately so that this case can be allowed to finally issue.

Dr. Souw's Biased Views Adopted by the Committee are Further Demonstrated by Citation to His Own Work

The genuine conflict of interest that surrounds the questionable employment history of Dr. Souw is not the only source of bias he brings to this case. Dr. Souw also demonstrates extreme bias by citing two of his own technical papers published in the journal *Physica* to support the rejection of Applicant's claims on theoretical grounds. This procedural miscue is inherently unfair for two obvious reasons.

First, the Committee fails to show that the journals in which Dr. Souw's technical papers appear are any more "scientifically qualified" with appropriate review process than the journals that published Applicant's papers. Yet the Committee gives Dr. Souw's papers the "credibility that peer-reviewed articles have," while refusing to bestow that same credibility on Applicant's peer-reviewed journal articles. [See, for example, page 5 of the Committee's May 19, 2004 Office Action in U.S. App'n Ser. No. 09/362,693] The Committee's reliance on Dr. Souw's papers merely illustrates an obvious double standard and demonstrates once again its bias against Applicant in failing to fairly consider his experimental evidence published in prestigious journals as scientifically qualified, which evidence far outweighs the scant evidence produced by Dr. Souw. This double standard is but another example of the Committee's arbitrary and capricious handling of Applicant's cases.

Second, the Committee's reliance on the views of Dr. Souw based on citation of his own technical papers against Applicant is inherently unfair since Dr. Souw is no longer an impartial judge. How can the Examiner claim to be unbiased in response to arguments criticizing his own technical papers? The answer is obvious: he can't.

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[125] Dr. Souw's extreme bias is demonstrated by many of his outlandish statements adopted by the Committee, such as his comment equating Applicant's sophisticated hydrogen technology with "crop circles"! [See May 12, 2005 Advisory Action in U.S. App'n Ser. No. 09/669,877.]

In any case, now that the Committee has relied upon Dr. Souw's own scientific research to support its rejections, Applicant is entitled to know from the Committee certain details of the Examiner's background, including a complete disclosure of his technical education and past work experiences. The Committee's steadfast refusal to disclose that relevant information only provides further basis for overturning its rejections.

In a previous Office Action, the Committee tried, but failed, to rationalize why Dr. Souw should be allowed to cite without scrutiny his own technical papers against Applicant:

> Applicant note[s] the involvement of Examiner Bernard Souw in the examination of another of his applications, and that Examiner Souw had previously worked for Brookhaven National Labs. Two things are thus pointed out. First, examiners are allowed, and even encouraged, to consult other examiners on matters of science. Dr. Souw is the author of the attached Appendix. While originally written for Serial No. 09/513,768, the Appendix is considered relevant to the present application for reasons stated below. Second, the employment history of examiners, including those acting in a consulting role, is irrelevant to the examination thereof, except where there is a genuine conflict of interest. [See April 14, 2004 Office Action at p. 4 in U.S. App'n. Ser. No. 09/008,947]

The first point—that the PTO generally encourages consultation with other Examiners—is not even in dispute and is therefore irrelevant. The present objection to the Committee's consultation of Dr. Souw is his obvious bias in citing papers he authored, which requires that he critically analyze and respond to criticisms of his own work.

The PTO's second point—that the employment history of Examiners is only relevant when there is a "genuine conflict of interest"—is a backward standard that defies common sense.[126] As Applicant aptly demonstrated above, it was only after he was forced to conduct his own investigation into Dr. Souw's relevant employment history—because the Committee improperly withheld that information—that Applicant

[126] Applicant disputes that a <u>genuine</u> conflict of interest is actually necessary to show bias—even the <u>appearance</u> of a conflict should be sufficient to taint the views expressed by Dr. Souw. This point is moot, however, since genuine conflicts of interest based on Dr. Souw's outside business activities have been shown, which conflicts have fatally infected Dr. Souw's biased views adopted by the Committee.

was then able to demonstrate the existence of a genuine conflict in this case. It would have been impossible to demonstrate that conflict had Applicant not known the Examiner's relevant employment history involving his ongoing ownership and operation of BMS Enterprise and, apparently, the Committee would have liked to keep it that way.

In any case, now that Applicant has satisfied the Committee's "genuine conflict of interest" requirement, the Committee is obligated under its own backward standard to disclose the complete nature and scope of Dr. Souw's employment history so that a full determination can be made regarding the existence of other such conflicts.

Further Comfirmation of the Secret Committee's "Allowance is Not an Option" Policy and Its Refusal to Grant Applicant a Fair and Expeditious Hearing

Examiner Wayner Confirmed the Committee's Official Policy Not to Allow Applicant's Cases

As discussed above, Examiner Langel initially advised Applicant that a Committee of PTO officials he could not identify was responsible for authoring the Office Actions he was instructed to sign as the named Examiner of record in the cases assigned to him. Examiner Kalafut later confirmed that he was also merely the named Examiner of record and that he too did not author the Office Actions issued by the Committee in his cases. Given that these two senior PTO employees, having over 50 years of experience between them, were being used as Examiners-in-name-only by this "Secret Committee," Applicant found it odd that another named Examiner, William Wayner, would make the following statement in another BlackLight application to which he was assigned:

> For the record this Examiner makes it clear that there is no committee in charge of this application, that all of the office actions in this case have been done by me alone an[d] that I have never been told that I could not allow this application. [See April 26, 2004 Office Action issued in U.S. App'n Ser. No. 09/181,180 ('180 application).]

Applicant's initial doubt regarding the veracity of that statement was confirmed in an initial telephone conversation held on October 5, 2004, between Applicant's counsel,

Jeffrey A. Simenauer, and Mr. Wayner, following his retirement from the PTO as an Examiner, and in a follow-up telephone conversation held on October 25, 2004.

Sometime in mid-September, Mr. Wayner had called and left Mr. Simenauer, a former PTO colleague, a telephone message informing him of his retirement and his desire to secure patent search work to do in his spare time. Mr. Simenauer returned Mr. Wayner's call and spoke to him on October 5th about doing some possible work, after which the conversation turned to Mr. Wayner's involvement in the examination of the '180 application. The substance of that conversation was confirmed in an e-mail Mr. Simenauer sent to Mr. Wayner on October 15, 2004. [See Tab S]

During the October 5 phone conversation, Mr. Wayner was very candid in complimenting Dr. Mills for the way he had handled himself during the February 11, 2003 Interview, commenting that "Mills is one hell of a persuasive man" and that "he came across as very convincing" at the Interview. In his October 15 e-mail, Mr. Simenauer thanked Mr. Wayner for those comments, which he indicated had been forwarded to Dr. Mills.

Mr. Simenauer then told Mr. Wayner that, while he disagreed with the positions Mr. Wayner had expressed during the Interview, including his skepticism regarding the operability of Mills' invention, he still respected those views. Mr. Simenauer, however, made clear to Mr. Wayner that what really upset him were the questionable actions that the PTO has taken against BlackLight prejudicing its patent rights. In that regard, Mr. Simenauer recalled Examiner Langel's resignation from examining Applicant's cases "for moral and ethical reasons" due to instructions he had been given to misrepresent the record to promote the PTO's "allowance is not an option" policy. Specifically, Mr. Simenauer reminded Mr. Wayner of how Examiner Langel was told to say that he was against allowing Dr. Mills' applications, when in fact he favored doing so, and that he had authority to issue Dr. Mills his patents, when he clearly had no such authority.

Mr. Wayner confirmed this official position of the Patent Office "not to allow [Dr. Mills'] cases" and admitted that he could not tell Mr. Simenauer this while he was still working at the PTO. As stated in his October 15 e-mail, Mr. Simenauer appreciated Mr. Wayner's honesty and understood why he had previously remained silent.

As further stated in his e-mail, Mr. Simenauer had first decided not to ask Mr. Wayner to go "on the record" with this information, given that Applicant already had a record of Examiner Langel's statements that the PTO had in place an "allowance is not an option" policy and that he was asked to misrepresent his authority to issue patents in BlackLight's cases. Mr. Simenauer mentioned, however, that a problem had arisen that had caused him to reconsider that decision. Mr. Simenauer explained that his review of Mr. Wayner's last Office Action in the '180 application had turned up the above-quoted statement that "I [Wayner] have never been told that I could not allow this application," which contradicted what Mr. Wayner had told Mr. Simenauer previously on the phone regarding his lack of authority to allow it.

In view of Examiner Langel's admission that he was told by senior PTO officials that he did not have authority to allow BlackLight's applications under any circumstances, but that he should give the false impression that he did have such authority, Mr. Simenauer expressed concern in his October 15 e-mail that the PTO might have put Mr. Wayner in a similar uncomfortable position when he stated that he had authority to allow the '180 application. Mr. Simenauer then informed Mr. Wayner that, as BlackLight's patent counsel, he was obligated to press the matter. Knowing Mr. Wayner to be "a man of utmost integrity," Mr. Simenauer further stated that he felt comfortable requesting "[his] assistance in simply uncovering the true facts regarding the PTO's policy decisions that have been made against BlackLight."

In response to Mr. Simenauer's e-mail, Mr. Wayner called him on October 25, 2004 and left a message, which call was then returned the same day by Mr. Simenauer and the undersigned co-counsel, Jeffrey S. Melcher. At no time during this subsequent telephone conversation did Mr. Wayner deny the substance of his earlier October 5th conversation with Mr. Simenauer as reflected in the October 15th e-mail. Rather, Mr. Wayner started the conversation by stating, "You should know better. I don't want to get involved in this anymore." Mr. Wayner further stated that he did not want to talk any further about the subjects discussed in Mr. Simenauer's confirmation e-mail and that, in his words, "you will have to go by what's on the record," making clear to Applicant's counsel that he would not accept their request for assistance regarding the truth of his statements in the present Office Action.

Mr. Wayner also stated that while he wanted to continue his personal friendship with Mr. Simenauer, he also wanted "to stay out of the [BlackLight] case." Mr. Simenauer apologized for troubling him with this matter and informed Mr. Wayner that he may not be able to remain out of the BlackLight case against the PTO if it were to go to trial following an appeal to the PTO Board. Somewhat nervously, Wayner responded by stating that "it is a very dangerous situation" for him, and again made clear that he did not want to talk about it any further. Mr. Simenauer told Mr. Wayner that he understood and sympathized with his situation and that he did not want to put him in the uncomfortable position of having to say anything more on the subject.

Mr. Wayner then stated that he had changed his mind about seeking search work from Mr. Simenauer as he had initially requested since, in his words, "I don't want it to look like a *quid pro quo*." Again, Mr. Simenauer expressed his understanding of the situation Mr. Wayner found himself in and that ended the conversation.

In light of these unfortunate developments, Applicant must demand that the PTO Committee cease and desist from any further attempts to cloud the administrative record in his cases so as to make it appear that the "Examiners-in-name-only" are solely responsible for its actions. As with the situation involving instructions that led to Examiner Langel's resignation "for moral and ethical reasons," Applicant further demands that the Committee provide a complete account of the facts and circumstances that led to the questionable statements appearing in the Office Action signed by Examiner Wayner in the '180 application prior to his retirement.

Examiner Tsang-Foster Has Confirmed the Committee's
<u>Refusal to Fairly Evaluate Applicant's Scientific Evidence</u>

The Committee's "allowance is not an option" policy has been further advanced by another Examiner-in-name-only, Susy N. Tsang-Foster. In those cases in which her name appears, Examiner Tsang-Foster basically admits to the Committee's continued refusal to grant Applicant a fair hearing on the mountain of scientific evidence, <u>submitted at its request</u>, proving the existence of lower energy states of hydrogen. [See, for example, the May 12, 2005 Advisory Action issued in U.S. App'n Ser. No.

09/669,877.][127]

With now over 60 peer-reviewed articles published in respected scientific journals—and the list keeps growing—Applicant has achieved acceptance in the scientific community, which was improperly required by the Committee as a condition for patentability in this case. Rather than fully and fairly evaluate Applicant's compelling experimental evidence, the Committee now takes the extreme position that all of this evidence "detract[s] from the central issue that the hydrino does not theoretically exist." [See May 12, 2005 Advisory Action in U.S. App'n Ser. No. 09/669,877 at page 2 (emphasis added).] Out of the multitude of baseless arguments contrived by the Committee, this one truly stands out as perhaps the most outrageous.

Applicant has spent enormous amounts of effort and money complying with the PTO's arbitrary requirement that he publicly disclose his confidential data in peer-reviewed publications to prove the existence of lower-energy hydrogen. Now, incredibly, Applicant is being told that those efforts have been for naught since, according to the Committee, "all of applicant's data cannot prove what is not theoretically possible." [See May 12, 2005 Advisory Action in U.S. App'n Ser. No. 09/669,877 at page 2.] This statement is not only grossly erroneous, but it also contradicts the Committee's own prior statements. Indeed, in previous Office Actions, the Committee has responded to Applicant's criticism by vehemently denying that it was taking the position that the existence of lower-energy hydrogen was impossible. For instance, Committee-member Souw tried to claim:

> Contrary to Applicant's allegation on pg. 13, 1st full paragraph, lines 2-4, the PTO's view is not at all that the existence of lower-energy hydrogen were impossible, but instead, that (a) Applicant's invention is not supported by any experimental fact or evidence, and (b) the underlying

[127] The Committee created another procedural morass in that case when it issued the May 12, 2005 Advisory Action, which required Applicant's response to forty-four pages of new arguments and twenty-one newly cited references. It was bad enough that the Committee included these voluminous new arguments in an Advisory Action without extending Applicant the courtesy of withdrawing the finality of the April 22, 2004 Office Action and establishing a new time period for him to respond. The Committee only made the situation more onerous by mailing its Advisory Action on May 12, 2005, almost seven months after Applicant had responded to that Final Office Action on October 22, 2004, leaving Applicant less than ten days to respond.

Applicant attempted to correct this latest abuse of PTO procedures—effectively denying him a fair hearing—by requesting that a new time period be set. That request was initially ignored and then later denied without a satisfactory explanation.

> theory (i.e., GUT/CQM) fails to support the invention, because it contains too many flaws. [Souw Appendix at p. 3 attached to the Committee's Final Office Action mailed August 24, 2004 in Applicant's U.S. Ser. No. 08/467,051 (emphasis added).]

Such inconsistent positions permeate all of the Committee's Office Actions and provide further grounds for overturning the pending rejections.

As Applicant has consistently argued, the only way to settle the theoretical argument on whether lower-energy hydrogen actually exists is to properly evaluate the real-world evidence that Applicant and independent third parties have generated. For the Committee to now assert that this real-world evidence "detract[s] from the central issue that the hydrino does not theoretically exist" turns science on its head and is an embarrassment to a government agency charged with "promot[ing] the Progress of Science and useful Arts." [See U.S. Constitution, Art. I, Sect. 8, Clause 8.]

Demand for Information and Redress

Applicant believes that the totality of events documented above are highly relevant to the PTO's examination of all of BlackLight's patent applications and accurately describe the detrimental effects that examination has had on Applicant's patent rights. These events further demonstrate the PTO's failure to provide adequate safeguards to the interests of Applicant, including fair and expeditious examination, as contemplated by the Federal Circuit in its June 28, 2002 Decision. Applicant therefore respectfully demands that the PTO provide certain information and redress, including:

1) identification of all Examiners or other PTO personnel who were consulted, or otherwise provided input, in the examination of BlackLight's applications;

2) identification of all other persons from outside the PTO who were consulted, or otherwise provided input, in the examination of BlackLight's applications;

3) identification of all PTO officials responsible for withdrawing BlackLight's five allowed applications from issuance and a complete disclosure of the facts and circumstances surrounding that withdrawal action;

4) identification of all outside sources of information who may have precipitated, or otherwise contributed to, the PTO withdrawing BlackLight's five allowed applications from issuance and a complete disclosure of the facts and circumstances surrounding those actions;

5) a complete disclosure of the facts and circumstances surrounding the removal of Examiner Langel from examining BlackLight's applications and the transfer those cases to a new Examiner, including, but not limited to, identification of all persons involved in those actions;

6) the information sought above in connection with the questionable statements made by Examiner Wayner in the '180 application;

7) the information sought above in connection with Dr. Souw's conflict of interest in owning and operating BMS Enterprise while assigned by the PTO to examine and reject BlackLight's pending patent applications;

8) the immediate removal of Dr. Souw, and other members of the Secret Committee, as Examiners in all pending BlackLight applications, and the reinstatement of Examiner Langel to his position as the Examiner of record in those cases to which he had been previously assigned;

9) the examination and issuance of all allowable BlackLight applications in accordance with the above-mentioned representations and agreements made at the February 11, 2003 Interview; and

10) as a matter of equity, the immediate issuance, without further examination, of all five of BlackLight's withdrawn patent applications due to the PTO's failure to provide the safeguards to the interests of Applicant, including fair and expeditious further examination, as contemplated by the Federal Circuit in its June 28, 2002 Decision.

Response to Specific Arguments Presented in the Final Office Action

Applicant reached agreements with the PTO during the February 11, 2003 Interview as to how it would conduct s itexamination of BlackLight's applications following the tumultuous the present Action, now defaults on those agreements, whereby examination prosecution history of these cases. The Secret Committee, in its subsequent Office Actions, including in this case reverts back to ignoring most of Applicant's scientific evidence on baseless theoretical grounds and applying improper patent standards consistent with its "allowance is not an option" policy. Despite the

unfairness of these actions, Applicant will not be deterred from seeking the patent rights to which he is entitled.

With that said, Applicant now turns to the Committee's latest arguments in the present Action, which primarily rely on the biased views of its newly appointed Examiner, Dr. Bernard Eng-Kie Souw, as expressed in his attached Appendix. Applicant rebuts each and every one of those arguments below and explains why they totally lack any merit. As previously discussed, the Committee's adoption of Dr. Souw's views to reject the claims in this case is also misguided due to his genuine conflict of interest in working as the lead scientist for a competing company while examining Applicant's cases and in citing his own technical papers against Applicant.

For these many reasons, the Committee's biased rejections are simply not credible and cannot stand up to Applicant's overwhelming experimental evidence of lower-energy hydrogen, which the Committee has either misconstrued or ignored altogether. Applicant therefore demands immediate allowance of all claims in this application and his other pending cases.

Applicant is once again disappointed to learn that the Committee has turned its back on an agreed upon standard, this time involving its self-imposed requirement that Applicant publish his experimental data supporting the existence of lower-energy hydrogen in peer-reviewed scientific journals. Incredibly, the Committee, on highly questionable grounds, summarily dismisses the entirety of that data. Applicant protests these arbitrary actions in the strongest terms possible and requests that the Committee reconsider its tenuous position.

To fully comprehend the unfairness of the Committee's dismissal of Applicant's scientific data, it should first be noted that it was the Committee that <u>required</u> Applicant, over his strenuous objections, to publish that data in peer-reviewed scientific journals. This requirement stemmed from an Interview held on February 21, 2001, during which Examiner Vasudevan Jagannathan refused to take seriously the data presented at the Interview because it had not been subjected to the peer-review process required by most scientific journals prior to publication. For instance, as discussed above, Examiner Jagannathan mischaracterized Applicant's highly reliable spectroscopic data as nothing more than a "bunch of squiggly lines."

Despite the fact that the Committee has never cited any authority to support its publication requirement, Applicant expended considerable effort—not to mention millions of research dollars—complying with it. Yet, now that Applicant has published his experimental data in over 60 technical papers appearing in a number of respected scientific journals, with another 50-plus papers soon to follow, Applicant is advised that those efforts were for naught. Applicant is appalled that the Committee has categorized his papers based contrived excuses for ignoring their contents.

Rather than fully and fairly evaluate Applicant's compelling experimental evidence, the Committee now takes the extreme position that all of this evidence "detract[s] from the central issue that the hydrino does not theoretically exist." [Advisory Action at page 2 (emphasis added).] Out of the multitude of baseless arguments that dominate the Committee's Advisory Action, this one truly stands out as perhaps the most outrageous.

Applicant has spent enormous amounts of effort and money complying with the PTO's arbitrary requirement that he publicly disclose his confidential data in peer-reviewed publications to prove the existence of lower-energy hydrogen. Now, incredibly, Applicant is being told that those efforts have been for naught since, according to the Committee, "all of applicant's data cannot prove what is not theoretically possible." [Advisory Action at page 2.] This statement is not only grossly erroneous, but it also contradicts the Committee's own prior statements. Indeed, in previous Office Actions, the Committee has responded to Applicant's criticism by vehemently denying that it was taking the position that the existence of lower-energy hydrogen was impossible. For instance, Committee-member Souw tried to claim:

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Such inconsistent positions permeate the Committee's present Advisory Action and

provides further grounds for overturning the pending rejections.

As Applicant has consistently argued, the only way to settle the theoretically argument on whether lower-energy hydrogen actually exists is to properly evaluate the real-world evidence that Applicant and independent third parties have generated. For the Committee to now assert that this real-world evidence "detract[s] from the central issue that the hydrino does not theoretically exist" turns science on its head and is an embarrassement to a government agency charged with "promot[ing] the Progress of Science and useful Arts." [See U.S. Constitution, Art. I, Sect. 8, Clause 8.]

This is but one of many examples of the outrageous positions the Committee has taken in its latest action. Another includes its contined reliance almost exclusively on the clearly biased views of Dr. Souw—who now equates Applicant's sophisticated hydrogen technology with "crop circles"!—in disregard of the genuine conflict created by his competing business interests. Indeed, the Committee fully adopts those biased views once again by including yet another lengthy submission (41 pages) authored by Dr. Souw as an Attachment to its Advisory Action (Souw Attachment IV).

The Committee merely repeats in the main body of that Action many of the same errors that plague the Souw Appendix, including numerous conflicting statements, mathematical errors, false premises, improper standards, misstatements of facts, and general confusion. Worse yet, the Committee in its latest Action has now gone even a step further over the line by accepting as fact the false and misleading statements of third parties who misrepresented published data in an attempt to torpedo the acceptance Applicant's technology has achieved in the scientific community.[128]

These cumulative errors have worked to deny Applicant the due process he is entitled to under applicable U.S. Patent Laws and PTO procedures. Applicant respectfully requests that the Committee rethink its combative approach to examining this application and once again follow the guidelines it previously had adopted for properly evaluating Applicant's scientific evidence.

Section 1

[128] Dr. Zimmerman's apparent pre-knowledge of this publication once again calls into question the role he and other APS officials, including Dr. Park, have played in sabotaging Applicant's patent rights.

With respect to the specific arguments advanced in the Action, the Committee begins by incorrectly asserting on page 3 that:

> As stated in the previous office actions, applicant's claimed invention is based on the existence of the hydrino atom which is contrary to the known laws and theories of chemistry and physics.

That statement is simply untrue and the Committee cannot cite to any known law of chemistry or physics that has been violated. That is because there are none—Applicant's invention is based on compliance with all physical laws, even at the atomic level. Rather than using postulated unverifiable theories that treat atomic particles as if they were not real, Applicant now applies physical laws to atoms and ions. The Committee's failure to comprehend this fact is fatal to its entire analysis.

In an attempt to provide some physical insight into atomic problems and starting with the same essential physics as Bohr of e^- moving in the Coulombic field of the proton with a true wave equation, as opposed to the diffusion equation of Schrödinger, a classical approach is explored that yields a remarkably accurate model and provides insight into physics on the atomic level. The proverbial view deeply seated in the wave-particle duality notion that there is no large-scale physical counterpart to the nature of the electron is shown to be incorrect. Physical laws and intuition may now be restored when dealing with the wave equation and quantum atomic problems.

Specifically, a theory of classical quantum mechanics (CQM) was derived from first principles as reported previously [1-7] that successfully applies physical laws to the solution of atomic problems that has its basis in a breakthrough in the understanding of the stability of the bound electron to radiation. Rather than using the postulated Schrödinger boundary condition: "$\Psi \to 0$ as $r \to \infty$", which leads to a purely mathematical model of the electron, the constraint is based on experimental observation. Using Maxwell's equations, *the classical wave equation is solved with the constraint that the bound $n = 1$-state electron cannot radiate energy.* Although it is well known that an accelerated *point* particle radiates, an *extended distribution* modeled as a superposition of accelerating charges does not have to radiate. A simple invariant physical model arises naturally, wherein the predicted results are extremely straightforward and internally consistent requiring minimal math as in the case of the

most famous equations of Newton, Maxwell, Einstein, de Broglie, and Planck on which the model is based. No new physics is needed; only the known physical laws based on direct observation are used. The solution of the excited states of one-electron atoms is given in R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, January 2005 Edition, BlackLight Power, Inc., Cranbury, New Jersey, (" '05 Mills GUT"):

Classical Quantum Theory of the Atom Based on Maxwell's Equations

> The old view that the electron is a zero or one-dimensional point in an all-space probability wave function $\Psi(x)$ is not taken for granted. The theory of classical quantum mechanics (CQM), derived from first principles, must successfully and consistently apply physical laws on all scales [1-7]. Stability to radiation was ignored by all past atomic models. Historically, the point at which QM broke with classical laws can be traced to the issue of nonradiation of the one electron atom. Bohr just postulated orbits stable to radiation with the further postulate that the bound electron of the hydrogen atom does not obey Maxwell's equations—rather it obeys different physics [1-10]. Later physics was replaced by "pure mathematics" based on the notion of the inexplicable wave-particle duality nature of electrons which lead to the Schrödinger equation wherein the consequences of radiation predicted by Maxwell's equations were ignored. Ironically, Bohr, Schrödinger, and Dirac used the Coulomb potential, and Dirac used the vector potential of Maxwell's equations. But, all ignored electrodynamics and the corresponding radiative consequences. Dirac originally attempted to solve the bound electron physically with stability with respect to radiation according to Maxwell's equations with the further constraints that it was relativistically invariant and gave rise to electron spin [11]. He and many founders of QM such as Sommerfeld, Bohm, and Weinstein wrongly pursued a planetary model, were unsuccessful, and resorted to the current mathematical-probability-wave model that has many problems [10, 11-14]. Consequently, Feynman for example, attempted to use first principles including Maxwell's equations to discover new physics to replace quantum mechanics [15].
>
> Physical laws may indeed be the root of the observations thought to be "purely quantum mechanical", and it was a mistake to make the assumption that Maxwell's electrodynamic equations must be rejected at the atomic level. Thus, in the present approach, the classical wave equation is solved with the constraint that a bound $n=1$-state electron cannot radiate energy.
>
> Herein, derivations consider the electrodynamic effects of moving charges as well as the Coulomb potential, and the search is for a solution representative of the electron wherein there is acceleration of charge

motion without radiation. The mathematical formulation for zero radiation based on Maxwell's equations follows from a derivation by Haus [16]. The function that describes the motion of the electron must not possess spacetime Fourier components that are synchronous with waves traveling at the speed of light. Similarly, nonradiation is demonstrated based on the electron's electromagnetic fields and the Poynting power vector.

It was shown previously [1-7] that CQM gives closed form solutions for the atom including the stability of the $n=1$ state and the instability of the excited states, the equation of the photon and electron in excited states, the equation of the free electron, and photon which predict the wave particle duality behavior of particles and light. The current and charge density functions of the electron may be directly physically interpreted. For example, spin angular momentum results from the motion of negatively charged mass moving systematically, and the equation for angular momentum, $\mathbf{r} \times \mathbf{p}$, can be applied directly to the wave function (a current density function) that describes the electron. The magnetic moment of a Bohr magneton, Stern Gerlach experiment, g factor, Lamb shift, resonant line width and shape, selection rules, correspondence principle, wave particle duality, excited states, reduced mass, rotational energies, and momenta, orbital and spin splitting, spin-orbital coupling, Knight shift, and spin-nuclear coupling, and elastic electron scattering from helium atoms, are derived in closed-form equations based on Maxwell's equations. The calculations agree with experimental observations.

The Schrödinger equation gives a vague and fluid model of the electron. Schrödinger interpreted $e\Psi^*(x)\Psi(x)$ as the charge-density or the amount of charge between x and $x+dx$ (Ψ^* is the complex conjugate of Ψ). Presumably, then, he pictured the electron to be spread over large regions of space. After Schrödinger's interpretation, Max Born, who was working with scattering theory, found that this interpretation led to inconsistencies, and he replaced the Schrödinger interpretation with the probability of finding the electron between x and $x+dx$ as

$$\int \Psi(x)\Psi^*(x)\,dx \tag{1}$$

Born's interpretation is generally accepted. Nonetheless, interpretation of the wave function is a never-ending source of confusion and conflict. Many scientists have solved this problem by conveniently adopting the Schrödinger interpretation for some problems and the Born interpretation for others. This duality allows the electron to be everywhere at one time—yet have no volume. Alternatively, the electron can be viewed as a discrete particle that moves here and there (from $r=0$ to $r=\infty$), and $\Psi\Psi^*$ gives the time average of this motion.

In contrast to the failure of the Bohr theory and the nonphysical, adjustable-parameter approach of quantum mechanics, multielectron atoms [1, 5] and the nature of the chemical bond [1, 4] are given by exact closed-form solutions containing fundamental constants only. Using the nonradiative wave equation solutions that describe the bound electron having conserved momentum and energy, the radii are determined from the force balance of the electric, magnetic, and centrifugal forces that corresponds to the minimum of energy of the system. The ionization energies are then given by the electric and magnetic energies at these radii. The spreadsheets to calculate the energies from exact solutions of one through twenty-electron atoms are given in '05 Mills GUT [1] and are available from the internet [17]. For 400 atoms and ions the agreement between the predicted and experimental results is remarkable.

References[129]

1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, January 2005 Edition; posted at http://www.blacklightpower.com/bookdownload.shtml.
2. R. L. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.
3. R. L. Mills, "Classical Quantum Mechanics", submitted; posted at http://www.blacklightpower.com/pdf/CQMTheoryPaperTablesand%20Figures080403.pdf.
4. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", submitted; posted at http://www.blacklightpower.com/pdf/technical/H2PaperTableFiguresCaptions111303.pdf.
5. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One-Through Twenty-Electron Atoms", submitted; posted at http://www.blacklightpower.com/pdf/technical/Exact%20Classical%20Quantum%20Mechanical%20Solutions%20for%20One-%20Through%20Twenty-Electron%20Atoms%20042204.pdf.
6. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", submitted; posted at http://www.blacklightpower.com/pdf/technical/MaxwellianEquationsandQED080604.pdf.
7. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", submitted; posted at http://www.blacklightpower.com/pdf/technical/ExactCQMSolutionforAtomicHelium073004.pdf.
8. R. L. Mills, "The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics", submitted; posted

[129] The references cited here, and in other passages of Mills' papers quoted throughout this Response, should not be confused with the references cited on Applicant's master list.

athttp://www.blacklightpower.com/pdf/Feynman%27s%20Argument%20Spec%20UPDATE%20091003.pdf.
9. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
10. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
11. P. Pearle, Foundations of Physics, "Absence of radiationless motions of relativistically rigid classical electron", Vol. 7, Nos. 11/12, (1977), pp. 931-945.
12. V. F. Weisskopf, Reviews of Modern Physics, Vol. 21, No. 2, (1949), pp. 305-315.
13. H. Wergeland, "The Klein Paradox Revisited", *Old and New Questions in Physics, Cosmology, Philosophy, and Theoretical Biology*, A. van der Merwe, Editor, Plenum Press, New York, (1983), pp. 503-515.
14. A. Einstein, B. Podolsky, N. Rosen, Phys. Rev., Vol. 47, (1935), p. 777.
15. F. Dyson, "Feynman's proof of Maxwell equations", Am. J. Phys., Vol. 58, (1990), pp. 209-211.
16. H. A. Haus, "On the radiation from point charges", American Journal of Physics, Vol. 54, 1126–1129 (1986).
17. http://www.blacklightpower.com/new.shtml.

The hydrogen atom is solved correctly using classical quantum mechanics. It provides for the stability of the hydrogen atom based on Maxwell's equations; whereas standard quantum mechanics (SQM) does not. Further application of physical laws predicts that energy can be transferred nonradiatively to a catalyst that can resonantly accept the energy to form lower-energy states of hydrogen corresponding to an extension of the Rydberg states to lower levels. These states are confirmed experimentally.

Studies that experimentally confirm a novel reaction of atomic hydrogen which produces hydrogen in fractional quantum states that are at lower energies than the traditional "ground" ($n = 1$) state, a chemically generated or assisted plasma (rt-plasma), and produces novel hydride compounds are summarized above in the section entitled, "Lower-Energy Hydrogen Experimental Data" and include:

extreme ultraviolet (EUV) spectroscopy[130],

[130] Ref. Nos. 11-16, 20, 24, 27-29, 31-36, 39, 42-43, 46-47, 50-52, 54-55, 57, 59, 63, 65-68, 70-76, 78-79, 81, 83, 85, 86, 89, 91-93, 95-96, 98, 101, 104, 108-109, 110-112. The complete list of reference Nos. is shown below.

characteristic emission from catalysis and the hydride ion products[131],
lower-energy hydrogen emission[132],
plasma formation[133],
Balmer α line broadening[134],
population inversion of hydrogen lines[135],
elevated electron temperature[136],
anomalous plasma afterglow duration[137],
power generation[138],
excessive light emission[139], and
analysis of chemical compounds[140].

Section 2

The Committee's faulty analysis of Applicant's novel hydrogen technology continues on page 3 of its Action with the argument that:

> Applicant's theory of the hydrino atom predicts a new form of the hydrogen atom having energy states represented by <u>fractional quantum numbers</u> that are below the conventional ground state of the hydrogen atom. These energy states having <u>fractional quantum numbers</u> are contrary to the conventionally accepted energy states of the hydrogen atom having <u>positive integer quantum numbers</u> predicted by <u>quantum mechanics</u> that have been successfully verified by decades of independent, reproducible experimental results as stated in ATTACHMENT TO RESPONSE TO APPLICANT'S ARGUMENTS in paper #22 mailed on 7/20/2001 (hereinafter referred to as "ATTACHMENT in paper #22").

The Committee refuses to recognize that SQM has many problems that disqualifies it as providing the correct solution of the hydrogen atom in the nonradiative,

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[131] Ref. Nos. 24, 27, 32, 39, 42, 46, 51-52, 55, 57, 68, 72-73, 81, 89, 91, 108
[132] Ref. Nos. 14, 28-29, 33-36, 50, 63, 67, 70-71, 73, 75-76, 78-79, 86-87, 90, 92, 93, 98, 101, 104, 110-112
[133] Ref. Nos. 11-13, 15-16, 20, 24, 27, 32, 39, 42, 46-47, 51-52, 54-55, 57, 72, 81, 89, 91-93, 108-109
[134] Ref. Nos. 16, 20, 30, 33-37, 39, 42-43, 49, 51-52, 54-55, 57, 63-65, 68-69, 71-74, 81-85, 88-89, 91, 92, 93, 95-97, 105, 108-109, 114
[135] Ref. Nos. 39, 46, 51, 54, 55, 57, 59, 65-66, 68, 74, 83, 85, 89, 91
[136] Ref. Nos. 34-37, 43, 49, 63, 67, 73
[137] Ref. Nos. 12-13, 47, 81
[138] Ref. Nos. 30-31, 33, 35-36, 39, 43, 50, 63, 71-73, 76-77, 81, 84, 89, 92, 93, 98, 101, 104, 108, 110-112
[139] Ref. Nos. 11, 16, 20, 23, 31, 37, 43, 52, 72, 109
[140] Ref. Nos. 6-10, 19, 25, 38, 41, 44-45, 60-62, 64, 69, 75, 81-82, 87-88, 90, 92, 93, 94, 98, 100, 101, 104, 108, 110-112

stable n=1 state, as well as excited states, as discussed previously in:

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.
106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted.
102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One- Through Twenty-Electron Atoms", Physics Essays, submitted.
94. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", Physics Essays, in press.
80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.
58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.
21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

CQM correctly predicts not only the known stable n=1 state and the excited-state energy levels of atomic hydrogen, including the conjugate observables such as the fine structure, Lamb shift, electron spin, the g factor, and the hyperfine structure missed entirely by the Schrodinger Equation (SE), but it also correctly predicts new energy states formed by a nonradiative, resonant energy transfer to a catalyst. These states are also missed entirely by the SE. This is no surprise since the SE is not predictive; it is not based on observable physics, and it is purely mathematical.

Once again, studies that experimentally confirm a novel reaction of atomic hydrogen which produces hydrogen in fractional quantum states that are at lower energies than the traditional "ground" ($n = 1$) state, a chemically generated or assisted plasma (rt-plasma), and produces novel hydride compounds are summarized in the document entitled, "Lower-Energy Hydrogen Experimental Data" and include:

extreme ultraviolet (EUV) spectroscopy,[141]
characteristic emission from catalysis and the hydride ion products,[142]
lower-energy hydrogen emission,[143]
plasma formation,[144]
Balmer α line broadening,[145]
population inversion of hydrogen lines,[146]
elevated electron temperature,[147]
anomalous plasma afterglow duration,[148]
power generation,[149]
excessive light emission,[150] and
analysis of chemical compounds.[151]

Section 2a

The Committee further argues on page 4 of the Action that:

> With respect to applicant's general 161 page response, applicant mostly repeats his previous arguments which have been addressed by the Examiner as seen in all of the previous responses to applicant's arguments. Therefore, all of the Examiner's previous responses to applicant's arguments of record, and the appendixes included in all of the previous office actions to support the Examiner's arguments are incorporated by reference in their entirety into this present response to applicant's arguments.

It is simply not true that Applicant mostly repeats his previous arguments. To the contrary, Applicant has specifically and fully responded to each and every point

[141] Reference Nos. 11-16, 20, 24, 27-29, 31-36, 39, 42-43, 46-47, 50-52, 54-55, 57, 59, 63, 65-68, 70-76, 78-79, 81, 83, 85, 86, 89, 91-93, 95-96, 98, 101, 104, 108-112.
[142] Reference Nos. 24, 27, 32, 39, 42, 46, 51-52, 55, 57, 68, 72-73, 81, 89, 91, 108.
[143] Reference Nos. 14, 28-29, 33-36, 50, 63, 67, 70-71, 73, 75-76, 78-79, 86-87, 90, 92, 93, 98, 101, 104, 110-112.
[144] Reference Nos. 11-13, 15-16, 20, 24, 27, 32, 39, 42, 46-47, 51-52, 54-55, 57, 72, 81, 89, 91-93, 108, 109.
[145] Reference Nos. 16, 20, 30, 33-37, 39, 42-43, 49, 51-52, 54-55, 57, 63-65, 68-69, 71-74, 81-85, 88-89, 91, 92, 93, 95-97, 105, 108, 109.
[146] Reference Nos. 39, 46, 51, 54, 55, 57, 59, 65-66, 68, 74, 83, 85, 89, 91.
[147] Reference Nos. 34-37, 43, 49, 63, 67, 73.
[148] Reference Nos. 12-13, 47, 81.
[149] Reference Nos. 30-31, 33, 35-36, 39, 43, 50, 63, 71-73, 76-77, 81, 84, 89, 92, 93, 98, 101, 104, 108, 110-112.
[150] Reference Nos. 11, 16, 20, 23, 31, 37, 43, 52, 72. 109
[151] Reference Nos. 6-10, 19, 25, 38, 41, 44-45, 60-62, 64, 69, 75, 81-82, 87-88, 90, 92, 93, 94, 98, 100, 101, 104, 108, 110-112.

raised by the Committee and submitted experimental evidence to further expose its erroneous positions. It is the Committee who has failed to fully respond to Applicant's rebuttal arguments and to fairly evaluate his evidence.

Section 3

The Committee further argues on page 4 of the Action that:

> All of the Examiner's previous office actions and the present attached appendix by Examiner Bernard Souw explain over and over again why applicant's theory is mathematically and physically flawed. Applicant's flawed theory cannot predict the existence of the hydrino and conventional quantum mechanics forbids the theoretical existence of the hydrino. [Emphasis in original.]

Applicant has explained over and over again why SQM is not a valid theory and the Committee has in most cases failed to address, much less rebut, Applicant's position. The Committee continues to misstate that the Schrodinger equation (SE) is a law of nature. Laws are based on reality. That is, they are based on directly measurable parameters, such as energy, mass, electric fields, magnetic fields, forces, etc. The SE has as its parameter Psi, which has no physical basis in reality. This is discussed in detail in, F. Laloë, "Do we really understand quantum mechanics? Strange correlations, paradoxes, and theorems," Am. J. Phys. 69 (6), June 2001, 655-701, and has been pointed out in numerous papers by Applicant:

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.
106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted.
102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One- Through Twenty-Electron Atoms", Physics Essays, submitted.
94. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", Physics Essays, in press.
80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.
58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.
21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.

17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

The SE gives no stability to radiation and is not predictive of the conjugate parameters of the hydrogen atom. It does not even obey causality. This has been argued by even the founders of quantum mechanics, such as Schrodinger himself, de Broglie, Weisskopf, Einstein, and others as pointed out repetitively by Applicant. These essential points have been presented in responses to prior office actions, as well as in the papers cited above and citations therein. The Committee continues to refuse to face these inescapable realities of the failures and limitations of SQM. Even more disturbing is its refusal to engage Applicant on the overwhelming amount of data that directly confirms the existence of the disclosed new states of atomic hydrogen summarized in the section above entitled, "Lower-Energy Hydrogen Experimental Data".

Many postulated theories of physics have been weakened or disproven due to new real-world measurements. The observation of the acceleration of the expansion of the cosmos predicted by Applicant's theory years before it was confirmed experimentally undercuts the traditional "Big Bang" origin of the universe. The observation from the Hubble images that time is continuous disproves string theories and the Heisenberg Uncertainty principle. The failure to find the Higgs boson undercuts the standard model as providing no basis for masses of fundamental particles; whereas Applicant accurately calculates the masses in closed form, including the mass of the top quark before it was detected at the D0 detector. Applicant's theory is based on physical laws and unifies Maxwell's equations with Special and General relativity and atomic physics. Other hodgepodge theories based on postulates and pure mathematics are proving to be failures. The Committee's failure to concede these well-known facts

merely confirms its biases and the arbitrary approach it has taken to examining the present applications.

The data and the details of these results are given in the following papers and book:

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.
106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted.
102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One- Through Twenty-Electron Atoms", Physics Essays, submitted.
94. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", Physics Essays, in press.
80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.
58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.
21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

Section 4

Incredibly, after Applicant has already invested millions of dollars supplying the Committee with the published experimental evidence it required for patentability, the Committee now informs Applicant that his experimental evidence is of little or no value. On page 4 of its Action, the Committee argues that Applicant's real-world evidence of lower-energy hydrogen can be essentially ignored because it detracts from the fact that it does not theoretically exist:

It is also illogical for the applicant to analyze his own experimental data

> using his flawed hydrino theory to prove the existence of the hydrino atom as stated in the previous office actions. Since applicant's theory is scientifically and mathematically flawed, there is no theoretical foundation for the hydrino atom and all of applicant's data cannot prove what is not theoretically possible. All of applicant's own experimental evidence of record **detract** from the central issue that the hydrino does not theoretically exist. [Emphasis in original.]

The Committee has it completely backwards. Rather than the possibility that "lower-energy hydrogen does not theoretically exist", quantum mechanics does not physically exist. It is simply a mathematical postulate that can not be tested and has no basis in reality. Physical laws that predict, and experimental data that clearly confirms, the existence of lower-energy hydrogen do exist. Quantum mechanics provides no physical basis for any state of hydrogen. Particularly troublesome is that under SQM, the electron is not stable to radiation. This point is shown by Applicant's analysis [80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted], as well as by other theoreticians such as those at Princeton University who show that the Heisenberg Uncertainty Principle provides no atomic stability [E. H. Lieb, "The stability of matter", Reviews of Modern Physics, Vol. 48, No. 4, (1976), pp, 553-569].

Quantum mechanics is not even a theory, and its very premises are nonsensical. It is based on applying statistics to a single particle and a single event. This weird contrivance is then interpreted as meaning the electron can be everywhere at once with an infinite number of positions and energies simultaneously including those that go to infinity in the positive as well as **negative** directions. Even more problematic is that according to SQM the electron has no physical form until it is measured. Thus, according to the Committee's position, since it creates hydrogen, it can chose which states can exist in reality.

Furthermore, the success of SQM at reproducing numbers comes from the fact that it merely comprises internally inconsistent curve-fitting algorithms devoid of any physics. The ability of the founding equation, the Schrodinger equation (SE) and its solutions, to reproduce the Rydberg formula are touted as justifying the validity of

quantum mechanics as representing the nature of physics on the atomic scale. This false confidence gives rise to the practice of curve fitting problems other than the principal energy levels of one electron atoms (the only problem for which a closed-form equation arises) with adjustable-parameters. However, when the postulated SE is evaluated at its fundamental level, it becomes readily apparent that the SE is merely a complicated equivalent form of the Rydberg formula, to which it reduces. The SE has no predictability, nor does it contain any physical truth. It misses stability to radiation, electron spin, the Lamb shift, fine structure, hyperfine structure, g factor and many other observables as detailed previously (see papers below). The lack of predictability confirms that the SE is just a mathematical statement of an empirical relationship discovered a generation prior to it being postulated, and it is not a real theory. See:

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.
106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted.
102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One- Through Twenty-Electron Atoms", Physics Essays, submitted.
94. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", Physics Essays, in press.
80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.
58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.
21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

Finally, Applicant must once again highlight the Committee's inconsistent

positions in claiming that the existence of lower-energy hydrogen "is not theoretically possible." Ironically, when Applicant first criticized the Committee for taking that extreme position, its response was to chastise him for mischaracterizing its position, claiming it has never said that the existence of lower-energy hydrogen was "impossible." These inconsistent positions do little to provide Applicant with a fair and expeditious examination of his novel hydrogen technology. The time has come to stop this nonsense and fairly evaluate Applicant's technology so that his patents can once again be issued. Thus, while Applicant is certainly willing to debate the theoretical predictions of lower energy states of hydrogen, it is incumbent upon the Committee to follow proper patent standards and evaluate the real-world evidence confirming the existence of lower-energy hydrogen. To this day it has not done so.

Section 5

The Committee, on page 5 of the Action, misapprehends the implications of Applicant's evidence, in arguing that:

> Applicant in his present response continues to misinterpret his own evidence of record and cited prior art. The applicant also continues to misinterpret the Examiner's statements. The discussion below and the attached appendix illustrate some of applicant's misinterpretations.
>
> With respect to applicant's response on pages 122-133 regarding his NMR data, the applicant modifies his own NMR evidence of record by submitting a new declaration by Dr. Turner (filed in copending application 09/111,003 on 12/21/2004, a copy of which is attached to this office action). In the previous office action, the Examiner rebutted applicant's conclusion that the upfield shifts in his NIMR data are due to the alleged novel hydrino compound by responding that contaminants such as β-MgNiH have the same upfield shifts. In the previous office action, the Examiner pointed out that Dr. Turner's original declaration filed on 5/18/2000 states that he has never observed shifts in the region of -4 to -5 ppm in his 20 years of practicing NMR spectroscopy since 1978 except in applicant's samples (a copy of the declaration was attached to the previous office action). Just because Turner himself never observed shifts in the region from -4 to -5 ppm <u>does not provide positive evidence</u> that these are due to novel compounds and not due to any previously known compounds. [Emphasis in original.]

As stated in Turner's declaration, the compound that showed the upfield shift only contains potassium as the cation, not magnesium and nickel. So, the Committee's

argument that MgNiH has an upfield NMR shift is irrelevant. KH does not have an upfield shift. Nor does hydride substitution for chloride produce an upfield shift as detailed in the following articles:

112. R. L. Mills, J. He, Y. Lu, M. Nansteel, Z. Chang, B. Dhandapani, "Comprehensive Identification and Potential Applications of New States of Hydrogen", Central European Journal of Physics, submitted.
111. R. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrogen Species $H^-(1/4)$ and $H_2(1/4)$ as a New Power Source", Thermochimica Acta, submitted.
110. R. L. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrides as a New Power Source," Prepr. Pap.-Am. Chem. Soc., Div. Fuel Chem. 2005, 50(2).

Section 6

According to the Committee, on pages 5-6 of its Action:

The Examiner rebutted this statement in Turner's original declaration by citing references to Hayashi (Hayashi, S. et al. (1997) "Accurate determination of ^1H Knight shifts in Mg_2NiH_X and MgH_X by means of high-speed magic angle spinning," *Journal of Alloys and Compounds,* vol. 248, pp. 66-69 (Paper A); Hayashi, S. et a!. (1997) "^1H NMR and magnetization measurements of a nanostructured composite material of the Mg_2Ni-H system synthesized by reactive mechanical grinding," *Journal of Alloys and Compounds,* vol. 256, pp. 159-165 (Paper B); Hayashi, S. et a!. (1997) "Local structures and hydrogen dynamics in amorphous and nanostructured Mg-Ni-H systems as studied by ^1H and ^2H nuclear magnetic resonance," *Journal of Alloys and Compounds,* vol. 261, pp. 145-149 (Paper C)) which show that β-MgNiH has transitions in the -4 to -5 ppm region (see p. 48 of "ATTACHMENT in paper #22").

In response to the Examiner's evidence dated 8/23/2001 that β-MgNiH have transitions in the -4 to -5 ppm region, Turner now qualifies his original statement in the new declaration by adding a new paragraph that the shifts observed in the region from -4 to-5 ppm are only known to be due to transition metal hydrides such as β-MgNiH but that Ni and Mg were not detected in applicant's sample. Turner does not provide any additional evidence besides relying on the Examiner's provided evidence of β-MgNiH to support his general statement that shifts in the region from -4 to -5 ppm are only known to be due to transition metal hydrides. Turner's current statement now reflects <u>the evidence provided by the Examiner</u> that β-MgNiH have transitions in the region of -4 to -5 ppm. Turner does not

provide any solid evidence to support his general statement that upfield shifts in the -4 to -5 ppm region are known only to be due to transition metal hydrides. It is inaccurate and illogical to extrapolate a piece of prior art provided by the Examiner showing β-MgNiH having shifts in the -4 to -5 ppm to the general statement that upfield shifts in the -4 to -5 pm region are known only to be due to transition metal hydrides.

There is no speculation possible in this case. The contents of the sample are known by elemental analysis and K is not known to produce an upfield NMR shift with ordinary hydride. This result directly shows that new states of hydrogen are formed. Furthermore, these states have been confirmed by Fourier transform infrared (FTIR) spectroscopy which shows the corresponding molecule ($H_2(1/4)$ corresponding to $H^-(1/4)$). Furthermore, the electron-beam excitation spectrum on the compound KHI confirms the FTIR and NMR results:

112. R. L. Mills, J. He, Y. Lu, M. Nansteel, Z. Chang, B. Dhandapani, "Comprehensive Identification and Potential Applications of New States of Hydrogen", Central European Journal of Physics, submitted.
111. R. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrogen Species $H^-(1/4)$ and $H_2(1/4)$ as a New Power Source", Thermochimica Acta, submitted.
110. R. L. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrides as a New Power Source," Prepr. Pap.-Am. Chem. Soc., Div. Fuel Chem. 2005, 50(2).

Section 7

The Committee further commits clear error on pages 6-7 of the present Action, arguing that:

> Furthermore, applicant's and Turner's assertions that there are no contaminants in the sample are not convincing because these samples were not purified after the synthesis process. Applicant's experimental syntheses of KH*Cl, KH*Br, and KH*I were made from the corresponding alkali halide KC1, KBr, and K using potassium metal as the catalyst and each compound was prepared in a stainless steel glass cell comprising a Ni screen hydrogen dissociator, catalyst, and alkali halide or alkaline earth hydride (see Experimental section on pp. 966-967 of applicant's paper, Mills et al., "Identification of compounds containing novel hydride ions by nuclear magnetic resonance spectroscopy", International Journal of Hydrogen Energy 26 (2001) pp. 965-979). Ni was used as a hydrogen dissociator and can easily be present as a contaminant such as a nickel

hydride containing compound in the resulting products. [Emphasis in original.]

The problem with the Committee's simplistic analysis is that no nickel was detected by elemental analysis in the sample. This is just another example of the Committee's refusal to properly consider Applicant's scientific evidence based on strained reasoning and contrived excuses.

Section 8

The Committee continues its erroneous analysis on page 7 of the Action, asserting that:

> Turner states in the new declaration that the only compounds known to have chemical shifts at -4. 1 and -4.5 ppm are transition metal hydrides. Therefore, it is the Examiner's position that the peaks at -4.1 ppm and -4.5 ppm can be due to minute amounts of contaminants such as a transition metal hydride containing compound in applicant's samples.

The Committee's position is simply wrong. ^1H MAS NMR is known not to be a technique for trace analysis. Furthermore, elemental analysis can detect orders of magnitude lower concentrations. Thus, the Committee's proposed speculation that "minute amounts of contaminants such as a transition metal hydride" gives rise to the intense upfield shifted peaks was eliminated.

Section 9

The Committee is also wrong in stating on pages 7-8 of the Action:

> The Examiner notes that Turner has filed a new declaration on 8/24/2004 in a copending and related caes 09/111,003. This new declaration modifies the old declaration by changing the pulse angle from 15 to 35 in paragraph 7 and adding the new paragraph:
>
> "For sample 080304BLP1, in the ^{1}H MAS NMR spectrum two unusual signals were observed, at -4.1 and -4.5 ppm. The only compounds known to have chemical shifts in this region are transition metal hydrides, in particular Mg_2NiH_4. Elemental analysis (Gaibraith Laboratories, Inc., Knowville, TN) showed that Mg and Ni are not detected in this sample, and that K was the main metal present. Earlier NMR data has shown that the hydride of K appears at about 1.0 ppm. Therefore, these results suggest that the signals at -4.1 and -4.5 ppm represent a novel species, and do not correspond to any known metal hydride."

> This new paragraph in Turner's declaration does not provide conclusive support that these upfield shifts are due to a novel species because all possible known transition compounds other than those including Ni that could have upfield shifts in this region have not been ruled out by the applicant or Turner. This new paragraph only states that K was the main metal present. It silent about what about other metal elements, especially transition metal elements, are present in this sample provided by the applicant.

Transition elements were considered and eliminated by Turner as the source of the up-field shifted peaks using elemental analysis as stated in the Turner declaration. See also Sections 6-8 above.

Section 10

The Committee seeks desperately to find another excusse to dismiss Applicant's evidence by further erroneously arguing on page 8 of the Action that:

> Furthermore, it is also possible that a previously unstudied, ordinary, non-transition metal hydride compound having upfield shifts is present in the sample. [Emphasis in original.]

The elemental analysis performed by Turner, as well that performed and published by Applicant, eliminates this possibility. See:

10. R. Mills, B. Dhandapani, N. Greenig, J. He, "Synthesis and Characterization of Potassium Iodo Hydride", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1185-1203.

The elemental content sufficient to be detectable by changing the proton NMR shift is shown to be only alkali and halide, which do not produce upfield-shifted NMR peaks as stated in the declaration by Turner, as well as in the following papers:

112. R. L. Mills, J. He, Y. Lu, M. Nansteel, Z. Chang, B. Dhandapani, "Comprehensive Identification and Potential Applications of New States of Hydrogen", Central European Journal of Physics, submitted.
111. R. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrogen Species $H^-(1/4)$ and $H_2(1/4)$ as a New Power Source", Thermochimica Acta, submitted.
110. R. L. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrides as a New Power Source," Prepr.

Pap.-Am. Chem. Soc., Div. Fuel Chem. 2005, 50(2).

In addition to elemental analysis, X-ray photoelectron spectroscopy and time-of-flight-secondary-ion-mass-spectroscopy (ToF-SIMs) also confirm the elemental composition as alkali, halide, and hydrogen:

111. R. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrogen Species $H^-(1/4)$ and $H_2(1/4)$ as a New Power Source", Thermochimica Acta, submitted.
110. R. L. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrides as a New Power Source," Prepr. Pap.-Am. Chem. Soc., Div. Fuel Chem. 2005, 50(2).
10. R. Mills, B. Dhandapani, N. Greenig, J. He, "Synthesis and Characterization of Potassium Iodo Hydride", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1185-1203.
8. R. Mills, B. Dhandapani, M. Nansteel, J. He, T. Shannon, A. Echezuria, "Synthesis and Characterization of Novel Hydride Compounds", Int. J. of Hydrogen Energy, Vol. 26, No. 4, (2001), pp. 339-367.

Section 11

The Committee also mistakenly argues on pages 8-9 of the present Action:

> Finally, applicant and Turner both agree that conventional transition metal hydrides have upfield shifts in the -4 to -5S ppm region. Since these NMIR signals are due to the hydrogen atom themselves in these conventional transition metal hydrides as measured by solid state proton NMR,and the position of the signal reflects the surrounding electronic environment of the hydrogen proton, the upfield shifts in these known conventional transition metal hydrides are due to hydrogen protons in a certain electronic environment surrounding the hydrogen protons and are not due to any novel states of the hydrogen atom in the conventional transition metal hydride compounds. Therefore, upfield shifts of protons in solid state proton NMR are known to be due to the electronic environment of the hydrogen proton that do not involve hydrino form of the hydrogen atom. Hydrinos are not necessary to explain the upfield shifts observed by solid state H NMR as evidenced by known transition metal hydrides having these upfield shifts in the same region.

There is no conventional explanation for the upfield-shifted peak in potassium hydride. The observed shift identically matches that predicted for lower-energy hydrogen. There are confirmations from many techniques. These results are

summarized in the following abstracts and reported in the corresponding papers:

112. **R. L. Mills, J. He, Y. Lu, M. Nansteel, Z. Chang, B. Dhandapani, "Comprehensive Identification and Potential Applications of New States of Hydrogen", Central European Journal of Physics, submitted.**

The data from a broad spectrum of investigational techniques strongly and consistently indicates that hydrogen can exist in lower-energy states then previously thought possible. Novel emission lines with energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,11$ were previously observed by extreme ultraviolet (EUV) spectroscopy recorded on microwave discharges of helium with 2% hydrogen [R. L. Mills, P. Ray, J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542]. These lines matched $H(1/p)$, fractional Rydberg states of atomic hydrogen wherein $n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, ..., \frac{1}{p}$; ($p \leq 137$ is an integer) replaces the well known parameter $n =$ integer in the Rydberg equation for hydrogen excited states. Evidence supports that these states are formed by a resonant nonradiative energy transfer to He^+ acting as a catalyst. Ar^+ and K also serve as catalysts since, like He^+, they meet the catalyst criterion—a chemical or physical process with an enthalpy change equal to an integer multiple of the potential energy of atomic hydrogen, $27.2\ eV$.

Two $H(1/p)$ may react to form $H_2(1/p)$ that have vibrational and rotational energies that are p^2 times those of H_2 comprising uncatalyzed atomic hydrogen. Rotational lines were observed in the 145-300 nm region from atmospheric pressure electron-beam excited argon-hydrogen plasmas. The unprecedented energy spacing of 4^2 times that of hydrogen established the internuclear distance as 1/4 that of H_2 and identified $H_2(1/4)$. The predicted products of alkali catalyst K are $H^-(1/4)$ which form a novel alkali halido hydride compound ($MH*X$) and $H_2(1/4)$ which may be trapped in the crystal. The ^1H MAS NMR spectrum of novel compound $KH*Cl$ relative to external tetramethylsilane (TMS) showed a large distinct upfield resonance at -4.4 ppm corresponding to an absolute resonance shift of -35.9 ppm that matched the theoretical prediction of $H^-(1/p)$ with p = 4. The predicted catalyst reactions, position of the upfield-shifted NMR peaks for $H^-(1/4)$, and spectroscopic data for $H^-(1/4)$ were found to be in agreement with the experimental observations as well as previously reported analysis of $KH*Cl$ containing this hydride ion.

The predicted frequencies of ortho and para-$H_2(1/4)$ were observed at 1943 cm^{-1} and 2012 cm^{-1} in the high resolution FTIR spectrum of $KH*I$ having a -4.6 ppm NMR peak assigned to $H^-(1/4)$. The 1943/2012 cm^{-1}-intensity ratio matched the characteristic ortho-to-para-peak-intensity ratio of 3:1, and the ortho-para splitting of 69 cm^{-1} matched that predicted. $KH*Cl$ having $H^-(1/4)$ by NMR was incident to the 12.5 keV electron-beam which excited similar emission of interstitial $H_2(1/4)$ as observed in the argon-hydrogen plasma. $H_2(1/p)$ gas was isolated by liquefaction of plasma gas at liquid nitrogen temperature and by decomposition of compounds ($MH*X$) found to contain the corresponding hydride ions $H^-(1/p)$. The $H_2(1/p)$ gas was dissolved in $CDCl_3$ and characterized by ^1H NMR. Considering solvent effects, singlet peaks upfield of H_2 were observed with a predicted integer spacing of 0.64 ppm at 3.47, 3.02, 2.18, 1.25, 0.85, and 0.22 ppm which matched the consecutive series $H_2(1/2)$, $H_2(1/3)$, $H_2(1/4)$, $H_2(1/5)$, $H_2(1/6)$, and $H_2(1/7)$, respectively.

Excess power was absolutely measured from the helium-hydrogen plasma. For an input of 41.9 W, the total plasma power of the helium-hydrogen plasma measured by water bath calorimetry was 62.1 W corresponding to 20.2 W of excess power in 3 cm^3 plasma volume. The excess power density and energy balance were high, 6.7 W/cm^3 and $-5.4\ X10^4\ kJ/mole\ H_2$ ($280\ eV/H\ atom$), respectively. In addition to power applications, battery and propellant reactions are proposed that may be transformational, and observed excited vibration-rotational levels of $H_2(1/4)$ could be the basis of a UV laser that could significantly advance photolithography.

111. **R. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrogen Species $H^-(1/4)$ and $H_2(1/4)$ as a New Power Source", Thermochimica Acta, submitted.**

The data from a broad spectrum of investigational techniques strongly and consistently indicates that hydrogen can exist in lower-energy states then previously thought possible. The predicted reaction involves a resonant, nonradiative energy transfer from otherwise stable atomic hydrogen to a catalyst capable of accepting the energy. The product is $H(1/p)$, fractional Rydberg states of atomic hydrogen wherein $n=\frac{1}{2},\frac{1}{3},\frac{1}{4},...,\frac{1}{p}$; ($p \le 137$ is an integer) replaces the well known parameter $n = \text{integer}$ in the Rydberg equation for hydrogen excited states. He^+, Ar^+, and K are predicted to serve as catalysts since they meet the catalyst criterion—a chemical or physical process with an enthalpy change

equal to an integer multiple of the potential energy of atomic hydrogen, $27.2\ eV$. Specific predictions based on closed-form equations for energy levels were tested. For example, two $H(1/p)$ may react to form $H_2(1/p)$ that have vibrational and rotational energies that are p^2 times those of H_2 comprising uncatalyzed atomic hydrogen. Rotational lines were observed in the 145-300 nm region from atmospheric pressure electron-beam excited argon-hydrogen plasmas. The unprecedented energy spacing of 4^2 times that of hydrogen established the internuclear distance as 1/4 that of H_2 and identified $H_2(1/4)$.

The predicted products of alkali catalyst K are $H^-(1/4)$ which form $KH*X$, a novel alkali halido (X) hydride compound, and $H_2(1/4)$ which may be trapped in the crystal. The ^1H MAS NMR spectrum of novel compound $KH*Cl$ relative to external tetramethylsilane (TMS) showed a large distinct upfield resonance at -4.4 ppm corresponding to an absolute resonance shift of -35.9 ppm that matched the theoretical prediction of $H^-(1/p)$ with p = 4. The predicted frequencies of ortho and para-$H_2(1/4)$ were observed at 1943 cm^{-1} and 2012 cm^{-1} in the high resolution FTIR spectrum of $KH*I$ having a -4.6 ppm NMR peak assigned to $H^-(1/4)$. The 1943/2012 cm^{-1}-intensity ratio matched the characteristic ortho-to-para-peak-intensity ratio of 3:1, and the ortho-para splitting of 69 cm^{-1} matched that predicted. $KH*Cl$ having $H^-(1/4)$ by NMR was incident to the 12.5 keV electron-beam which excited similar emission of interstitial $H_2(1/4)$ as observed in the argon-hydrogen plasma. KNO_3 and Raney nickel were used as a source of K catalyst and atomic hydrogen, respectively, to produce the corresponding exothermic reaction. The energy balance was $\Delta H = -17{,}925\ kcal/mole\ KNO_3$, about 300 times that expected for the most energetic known chemistry of KNO_3, and $-3585\ kcal/mole\ H_2$, over 60 times the hypothetical maximum enthalpy of $-57.8\ kcal/mole\ H_2$ due to combustion of hydrogen with atmospheric oxygen, assuming the maximum possible H_2 inventory. The reduction of KNO_3 to water, potassium metal, and NH_3 calculated from the heats of formation only releases $-14.2\ kcal/mole\ H_2$ which can not account for the observed heat; nor can hydrogen combustion. But, the results are consistent with the formation of $H^-(1/4)$ and $H_2(1/4)$ having enthalpies of formation of over 100 times that of combustion.

110. **R. L. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrides as a New Power Source," Prepr. Pap.-Am. Chem. Soc., Div. Fuel Chem. 2005, 50(2).**

Plasmas of certain catalysts such as K^+, Sr^+, and Ar^+ mixed with hydrogen were studied for evidence of a novel energetic reaction. These

hydrogen plasmas called resonant transfer- or rt-plasmas were observed to form at low temperatures (e.g. $\approx 10^3\ K$) and an extraordinary low field strengths of about 1-2 V/cm. Time-dependent line broadening of the H Balmer α line was observed corresponding to extraordinarily fast H (25 eV). Intense hydrogen Lyman emission, a stationary inverted Lyman population, excessive afterglow duration, highly energetic hydrogen atoms, characteristic alkali-ion emission due to catalysis, predicted novel spectral lines, and the measurement of a power beyond any conventional chemistry were also observed. Using a number of spectroscopic and analytical techniques, the reaction products were identified as atoms with energies that are an extension of the Rydberg series to lower states as well as the corresponding molecules and hydride ions. The results show the feasibility of this highly exothermic reaction as a new energy source.

Section 12

Continuing its error-plagued analysis, the Committee incorrectly asserts on pages 8-9 of the present Action:

> With respect to applicant's assertion on pages 57-85 of the amendment that there are 47 independent test results, a close examination of these 47 independent test results are mostly applicant's own work or those of his collaborators as stated and addressed in sections 19-25 of the ATTACHMENT IN PAPER #22 and in Part I of the attached appendix. Applicant's own work and those of his collaborators cannot be considered independent test results.

Applicant takes strong exception to these statements. The cited researchers who have repeated Applicant's experiments are independent and would not compromise their professional reputations by producing invalid data. In fact, pressure from peers, and in particular activist physicists that are out to defend quantum theory, have applied great pressure on independent validators to come to conclusions that do not support Applicant's results. Many of the researchers were not paid or very little support was provided. Some of them also came from testing laboratories for which it can not be claimed that they were collaborators. Since the technology is novel, Applicant's employees have assisted in replications, which further supports the validity of the results. Otherwise, Applicant would avoid collaborations with outside researchers. Applicant actively seeks validation.

Section 13a

The Committee continues by arguing on page 9 of the Advisory Action:

> With respect to applicant's assertion on page 96 of the amendment that his predicted previously unknown lower-energy hydrogen having fractional quantum numbers do not contradict, but rather, supplement the well-known higher energy states of hydrogen having integer quantum numbers, the Examiner disagrees for reasons given in sections 9 and 10 of the ATTACHMENT IN PAPER #22 that quantum mechanics forbids fractional quantum numbers for the energy levels of the hydrogen atom. Applicant's statement misinterprets conventional quantum mechanics which forbids these fractional quantum numbers in hydrogen atoms.

That is absolutely not true. Quantum theory is postulated and depending on the constant inserted in the corresponding differential equation, any energy level is possible. This issue is discussed in:

17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.

5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.

Section 13b

The Committee further asserts, without basis, on pages 9-10 of the Advisory Action:

> Applicant asserts on page 97 of the response that the Examiner's "conventional acceptance" standard introduces all sorts of inherent problems, among them the required degree of acceptance by the scientific community and the great length of time it often takes for such acceptance to take hold and that the Examiner's odd position appears to be that discoveries that are so novel as to require years to be scientifically accepted such as the Einstein's theory of relativity took decades to gain acceptance, is a sufficient basis for denying patent protection for inventions based on those discoveries. The applicant also asserts that the conventional acceptance standard is not supported by legal authority and that applicant can cite to any number of inventions that were granted patented protection based on unconventional approaches to well known problems.

> In response, applicant appears to be admitting and agreeing with the Examiner that his theory has not been accepted by the scientific community. Moreover, applicant states on page 123 of the present response that he "does not dispute the fact that until he put forward his novel theory, no established modern theory of science predicted the existence of lower energy states of hydrogen" and that all that proves is "the absolute novelty of Applicant's claimed invention, thus providing an additional basis for why Applicant is entitled to a patent". However, applicant appears to be misinterpreting patent law and legal precedent. Applicant's example of Einstein's theory of relativity is irrelevant because Einstein did not seek to and could not patent his discovery of the laws of nature (see the text of 35 USC 101).

Applicant most certainly does <u>not</u> agree with the Committee on any of these points. First, as stated numerous times—and never rebutted by the Committee—the "acceptance by the scientific community" standard imposed in this case has no legal support whatsoever. Second, even under this improper standard, Applicant has repeatedly shown in his Responses, including this one, that his scientific evidence of lower-energy hydrogen <u>has</u> gained acceptance in the scientific community. The failure to effectively rebut that evidence merely highlights the desperation reflected in the Committee's latest arguments.

The Committee's further assertions regarding Einstein's theory of relativity similarly fall flat. Applicant fails to see what that has anything to do with Applicant's entitlement to patents covering his development of pioneering technologies in the field of hydrogen chemistry. This latest irrelevant argument is yet another example of the Committee's intention to deny Applicant a fair and expeditious examination in this case.

<u>Section 13c</u>

The Committee further presents strained arguments on page 10 of its Action that are no more convincing:

> Furthermore, legal precedent in conjunction with patent law (see MPEP 2107.01) deny patentability of an invention that <u>is</u> <u>inconsistent with known scientific principles</u> such that the utility asserted by the applicant is thought to be incredible in the light of the knowledge of the art. *In re Citron,* 325 F.2d 248, 253, 139 USPQ 516, 520 (CCPA 1963).
>
> A good example of a novel "discovery" is cold fusion that can take years to (or never) be accepted by the scientific community and currently,

> the court has held that an invention based on cold fusion is not patentable because cold fusion is not a credible process of producing energy. *In re Swartz,* 232 F.3d 862, 56 USPQ2d 1703, (Fed. Cir. 2000). The applicant's argument that unconventional approaches to well known problems have been patented is not persuasive because these unconventional approaches are not inconsistent with known scientific principles whereas applicant's theory of the hydrino atom is inconsistent with known scientific principles and has not been accepted by the scientific community. Therefore, the Examiner's position denying patentability of applicant's incredible invention that is inoperative and lacks utility (under 35 USCIOI) is not odd but it is in agreement with office policy (see MPEP 2107.01) rooted in patent law and legal precedent.

These backward arguments merely demonstrate the Committee's profound confusion and total lack of appreciation for even the most basic principles underlying Applicant's novel hydrogen technology. Quantum theory is just that, a <u>theory</u>, yet the Committee now equates it to a law of nature. Ironically, Applicant's theory, which led him to the discovery of lower energy states of hydrogen, is based on classical laws of nature and, thus, contrary to the Committee's misplaced views, is <u>consistent</u> with known scientific principles. The Committee's assertions to the contrary as a basis for assuming Applicant's invention to be *per se* incredible and rejecting claims in this case is therefore completely erroneous and must be withdrawn.

Furthermore, as discussed many times previously, the Committee's assumption that Applicant's technology is *per se* incredible as an excuse to dismiss Applicant's scientific evidence without a fair hearing is not in agreement with office policy and most certainly is not rooted in patent law or other legal precedent. To the contrary, even the PTO's own policy proscribes such action and mandates that all supporting scientific evidence be properly considered before jumping to conclusions.

Unfortunately, the Committee once again chooses to hide behind its contrived standard of "acceptance by the scientific community" to avoid a fair hearing on Applicant's evidence. For the many reasons already stated, that tactic must also fail.

<u>Section 14</u>

The Committee wrongly accuses Applicant of error on page 11 of the Action, when, in fact, it has erred by arguing that:

With respect to astrophysical data as support of his hydrino theory, applicant continues to misinterpret the data of Labov and Bowyer on pages 126-129 of the present response where applicant assigns transitions observed by Labov and Bowyer as being due to the hydrino. The astrophysical data provided by Labov and Bowyer can be explained by conventional science without the need to use applicant's scientifically implausible theory of the hydrino atom. According to the document titled "Hydrocatalysis Technical Assessment, Prepared for Pacificorp, prepared by Technology Insights, dated August 2, 1996", submitted by applicant on 7/17/2002 in copending application 09/669,877, Labov and Bowyer dispute applicant's interpretation of their data. The applicant of the present application is the founder of Hydrocatalysis Power Corporation (HPC) now known as Blacklight Power, Inc. Pages 20-21 of the document states that spectra! data taken from the reference S. Labov and S. Bowyer, "Spectral Observations of the Extreme Ultraviolet Background", The Astrophysics Journal, 371, 810 (1991), were evaluated by HPC for indications of hydrino. HPC assigned peaks in the wavelength region of 80 to 650 Å to hydrino transitions. As shown in Table 4-1 on page 21 of the document, the HPC assignments contradict the alternative assignments made by the authors of the paper.

The Committee apparently does not seem to recognize that the explanation given by Labov and Bowyer is not credible based on discussions by the authors themselves. From Ref. #28 R. Mills, P. Ray, "Spectral Emission of Fractional Quantum Energy Levels of Atomic Hydrogen from a Helium-Hydrogen Plasma and the Implications for Dark Matter", Int. J. Hydrogen Energy, (2002), Vol. 27, No. 3, pp. 301-322:

B. Identification of Lower-Energy Hydrogen by Soft X-rays from Dark Interstellar Medium

a. Dark Matter

The Universe is predominantly comprised of hydrogen and a small amount of helium. These elements exist in interstellar regions of space, and they are expected to comprise the majority of interstellar matter. However, the observed constant angular velocity of many galaxies as the distance from the luminous galactic center increases can only be accounted for by the existence of nonluminous weakly interacting matter, dark matter. Dark matter exists at the cold fringes of galaxies and in cold interstellar space. It may account for the majority of the universal mass.

The identity of dark matter has been a cosmological mystery. Postulated assignments include t neutrinos, but a detailed search for signature emissions has yielded nil [49]. The search for signatures by the

Cryogenic Dark Matter Search (CDMS) developed to detect theorized Weakly Interacting Massive Particles (WIMPs) has similarly yielded nil [50-51]. WIMP theory's main competitor known as MACHO theory which assigns the dark matter to Massive Compact Halo Objects (MACHOs) which rather than elusive subatomic particles comprises ordinary baryonic matter in the form of burned-out dark stars, stray planets, and other large, heavy, but dark objects that must be ubiquitous throughout the universe. However, MACHO theory has also recently been ruled out based on lack of evidence of these dark objects observable by the brief ellipses caused by them moving in front of distant stars. Only a few such objects have been observed after exhaustively searching for over five years [50, 52].

It is anticipated that the emission spectrum of the extreme ultraviolet background of interstellar matter possesses the spectral signature of dark matter. Labov and Bowyer designed a grazing incidence spectrometer to measure and record the diffuse extreme ultraviolet background [53]. The instrument was carried aboard a sounding rocket, and data were obtained between $80\ \text{\AA}$ and $650\ \text{\AA}$ (data points approximately every $1.5\ \text{\AA}$). Several lines including an intense $635\ \text{\AA}$ emission associated with dark matter were observed [53] which has considerable astrophysical importance as indicated by the authors:

"Regardless of the origin, the $635\ \text{\AA}$ emission observed could be a major source of ionization. Reynolds (1983, 1984, 1985) has shown that diffuse $H\alpha$ emission is ubiquitous throughout the Galaxy, and widespread sources of flux shortward of $912\ \text{\AA}$ are required. Pulsar dispersion measures (Reynolds 1989) indicate a high scale height for the associated ionized material. Since the path length for radiation shortward of $912\ \text{\AA}$ is low, this implies that the ionizing source must also have a large scale height and be widespread. Transient heating appears unlikely, and the steady state ionization rate is more than can be provided by cosmic rays, the soft X-ray background, B stars, or hot white dwarfs (Reynolds 1986; Brushweiler & Cheng 1988). Sciama (1990) and Salucci & Sciama (1990) have argued that a variety of observations can be explained by the presence of dark matter in the galaxy which decays with the emission of radiation below $912\ \text{\AA}$.

The flux of $635\ \text{\AA}$ radiation required to produce hydrogen ionization is given by $F = \zeta_H / \sigma_\lambda = 4.3 X 10^4 \zeta_{-13}\ photons\ cm^{-2} s^{-1}$, where ζ_{-13} is the ionizing rate in units of $10^{-13} s^{-1}$ per H atom. Reynolds (1986) estimates that in the immediate vicinity of the Sun, a steady state ionizing rate of ζ_{-13} between 0.4 and 3.0 is required. To produce this range of ionization, the $635\ \text{\AA}$ intensity we observe would have to be distributed over 7% - 54% of the sky."

The first soft X-ray background was detected and reported [54] about 25 years ago. Quite naturally, it was assumed that these soft X-ray emissions were from ionized atoms within hot gases. Labov and Bowyer also interpreted the data as emissions from hot gases. However, the authors left the door open for some other interpretation with the following statement from their introduction:

"It is now generally believed that this diffuse soft X-ray background is produced by a high-temperature component of the interstellar medium. However, evidence of the thermal nature of this emission is indirect in that it is based not on observations of line emission, but on indirect evidence that no plausible non-thermal mechanism has been suggested which does not conflict with some component of the observational evidence."

The authors also state that "if this interpretation is correct, gas at several temperatures is present." Specifically, emissions were attributed to gases in three ranges: 5.5 < log T < 5.7; log T = 6; 6.6 < log T < 6.8.

The explanation proposed herein of the observed dark interstellar medium spectrum hinges on the possibility of energy states below the $n=1$ state, as given by Eqs. (2a) and (3). A number of experimental observations discussed in the Introduction section lead to the conclusion that atomic hydrogen can exist in fractional quantum states that are at lower energies than the traditional "ground" ($n=1$) state. The existence of fractional quantum states of hydrogen atoms explains the spectral observations of the extreme ultraviolet background emission from interstellar space [53], which may characterize dark matter as demonstrated in Table 3. (In these cases, a hydrogen atom in a fractional quantum state, $H(n_i)$, collides, for example, with a $n=\frac{1}{2}$ hydrogen atom, $H\left(\frac{1}{2}\right)$, and the result is an even lower-energy hydrogen atom, $H(n_f)$, and $H\left(\frac{1}{2}\right)$ is ionized.

$$H(n_i)+H\left(\frac{1}{2}\right)\rightarrow H(n_f)+H^{+}+e^{-}+photon \tag{55}$$

The energy released, as a photon, is the difference between the energies of the initial and final states given by Eqs. (2a) and (3) minus the ionization energy of $H\left(\frac{1}{2}\right)$, $54.4\ eV$.

Thus, lower-energy transitions of the type,

$$\Delta E = \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right) X 13.6\ eV - 54.4\ eV \quad n = 1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \ldots, \text{ and } n_i > n_f \tag{56}$$

induced by a disproportionation reaction with $H\left[\frac{a_H}{2}\right]$ ought to occur. The wavelength is related to ΔE by

$$\lambda\ (in\ \AA) = \frac{1.240\ X\,10^4}{\Delta E (in\ eV)} \tag{57}$$

The energies and wavelengths of several of these proposed transitions are shown in Table 2. Note that the lower energy transitions are in the soft X-ray region.

b. The Data And Its Interpretation

In their analysis of the data, Labov and Bowyer [53] established several tests to separate emission features from the background. There were seven features (peaks) that passed their criteria. The wavelengths and other aspects of these peaks are shown in Table 3. Peaks 2 and 5 were interpreted by Labov and Bowyer as instrumental second-order images of peaks 4 and 7, respectively. Peak 3, the strongest feature, is clearly a helium resonance line: $He(1s^1 2p^1 \to 1s^2)$. At issue here, is the interpretation of peaks 1, 4, 6, and 7. It is proposed that peaks 4, 6, and 7 arise from the $\frac{1}{3} \to \frac{1}{4}$, $\frac{1}{4} \to \frac{1}{5}$, and $\frac{1}{6} \to \frac{1}{7}$ hydrogen atoms transitions given by Eq. (55). It is also proposed that peak 1 arises from inelastic helium scattering of peak 4. That is, the $\frac{1}{3} \to \frac{1}{4}$ transition yields a $40.8\ eV$ photon ($303.9\ \AA$). Conspicuously absent is the $256\ \AA$ ($48.3\ eV$) line of He II which eliminates the assignment of the majority of the $303\ \AA$ line to the He II transition. When this photon strikes $He\ (1s^2)$, $21.2\ eV$ is absorbed in the excitation to $He\ (1s^1 2p^1)$. This leaves a $19.6\ eV$ photon ($632.6\ \AA$), peak 1. For these four peaks, the agreement between the predicted values (Table 2) and the experimental values (Table 3) is remarkable.

One argument against this new interpretation of the data is that the transition $\frac{1}{5} \to \frac{1}{6}$ is missing—predicted at $130.2\ \AA$ by Eqs. (56-57). This missing peak cannot be explained into existence, but a reasonable rationale can be provided for why it might be missing from these data. The data obtained by Labov and Bowyer are outstanding when the region of the spectrum, the time allotted for data collection, and the logistics are considered. Nonetheless, it is clear that the signal-to-noise ratio is low and that considerable effort had to be expended to differentiate emission features from the background. This particular peak, $\frac{1}{5} \to \frac{1}{6}$, is likely to be

only slightly stronger than the $\frac{1}{6} \rightarrow \frac{1}{7}$ peak (the intensities, Table 3, appear to decrease as n decreases), which has low intensity. Labov and Bowyer provided their data (wavelength, count, count error, background, and background error). The counts minus background values for the region of interest, $130.2 \pm 5\ \AA$, are shown in Table 4 (the confidence limits for the wavelength of about $\pm 5\ \AA$ are the single-side 1 confidence levels and include both the uncertainties in the fitting procedure and uncertainties in the wavelength calibration). Note that the largest peak (count – background) is at $129.64\ \AA$ and has a $counts\ -\ background = 8.72$. The $counts\ -\ background$ for the strongest signal of the other hydrino transitions are: $n = 1/3$ to $n = 1/4$, 20.05; $n = 1/4$ to $n = 1/5$, 11.36; $n = 1/6$ to $n = 1/7$, 10.40. Thus, there is fair agreement with the wavelength and the strength of the signal. This, of course, does not mean that there is a peak at $130.2\ \AA$. However, it is not unreasonable to conclude that a spectrum with a better signal-to-noise ratio might uncover the missing peak. With the assignment of the $\frac{1}{5} \rightarrow \frac{1}{6}$ transition, all of the hydrogen transitions $\frac{1}{3} \rightarrow \frac{1}{4}$, $\frac{1}{4} \rightarrow \frac{1}{5}$, $\frac{1}{5} \rightarrow \frac{1}{6}$, and $\frac{1}{6} \rightarrow \frac{1}{7}$ are observed over the recorded spectral range, and the 632.6 Å peak is identified.

Section 15

On pages 11-12 of its Action, the Committee further argues that:

> Page 21 of the document also states that Bowyer (an astrophysicist and author of the astrophysics journal paper cited above) disputed the HPC interpretation of the data and that the paper on the HPC interpretation submitted to the Astrophysical Letters and Communications was not accepted for publication. The document also states on page 21 that the low energy hydrogen concept and its implications regarding data interpretation has not received general review or acceptance by the astrophysics community. Thus, applicant's assertions regarding the existence of hydrino based on observations of radiation spectra from space, i.e., astrophysical data, have not been accepted by the astrophysics community as evidenced by the document submitted by applicant on 7/17/2002 in copending application 09/669,877 since a more credible scientific alternative exists to explain the spectral data.

The explanation given by Labov and Bowyer is not credible as discussed above in Section 21 of this Response. The data matches hydrinos. The data is now published in a peer-reviewed journal: 28. R. Mills, P. Ray, "Spectral Emission of Fractional

Quantum Energy Levels of Atomic Hydrogen from a Helium-Hydrogen Plasma and the Implications for Dark Matter", Int. J. Hydrogen Energy, (2002), Vol. 27, No. 3, pp. 301-322. The assignment to hydrino has further been validated by the identification of hydrino lines. Several peer-reviewed articles have been published that directly show and assign the hydrino spectra lines:

67. R. L. Mills, P. Ray, "Extreme Ultraviolet Spectroscopy of Helium-Hydrogen Plasma", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542.
50. R. L. Mills, P. Ray, J. Dong, M. Nansteel, B. Dhandapani, J. He, "Spectral Emission of Fractional-Principal-Quantum-Energy-Level Atomic and Molecular Hydrogen", Vibrational Spectroscopy, Vol. 31, No. 2, (2003), pp. 195-213.
33. R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "New Power Source from Fractional Quantum Energy Levels of Atomic Hydrogen that Surpasses Internal Combustion", J Mol. Struct., Vol. 643, No. 1-3, (2002), pp. 43-54.
29. R. Mills, P. Ray, "Vibrational Spectral Emission of Fractional-Principal-Quantum-Energy-Level Hydrogen Molecular Ion", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 533-564.
28. R. Mills, P. Ray, "Spectral Emission of Fractional Quantum Energy Levels of Atomic Hydrogen from a Helium-Hydrogen Plasma and the Implications for Dark Matter", Int. J. Hydrogen Energy, (2002), Vol. 27, No. 3, pp. 301-322.

Assignments to known species and contaminants were investigated and ruled out. For example, extreme ultraviolet (EUV) spectroscopy was recorded on microwave discharges of helium with 2% hydrogen. Novel emission lines were observed with energies of $q \cdot 13.6\ eV$, $q = 1,2,3,7,9,11.$ or $q \cdot 13.6\ eV$, $q = 4,6,8$ less $21.2\ eV$ corresponding to inelastic scattering of these photons by helium atoms due to excitation of $He\,(1s^2)$ to $He\,(1s^1 2p^1)$. These strong emissions are not found in any single gas plasma, and cannot be assigned to the known emission of any species of the single gases studied such as H, H^-, H_2, H_2^+, H_3^+, He, He_2^*, and He^+, known species of the mixture such as He_2^+, HeH^+, HeH, HHe_2^+, and HHe_n^+ and He_n, or possible contaminants as given in Ref. 67.

J. Phys. D is a top-tiered physics journal. The spectra were extensively peer reviewed. The publication unequivocally assigns the lines to hydrino as shown explicitly in journal article #67:

> The elimination of known explanations indicate a new result. Since the novel peaks were only observed with helium and hydrogen present, new hydrogen, helium, or helium-hydrogen species are possibilities. It is well known that empirically the excited energy states of atomic hydrogen are given by Rydberg equation (Eq. (2a) for $n > 1$ in Eq. (2b)).
>
> $$E_n = -\frac{e^2}{n^2 8\pi\varepsilon_o a_H} = -\frac{13.598\ eV}{n^2} \quad \text{(2a)}$$
>
> $$n = 1,2,3,\ldots \quad \text{(2b)}$$
>
> The $n = 1$ state is the "ground" state for "pure" photon transitions (i.e. the $n = 1$ state can absorb a photon and go to an excited electronic state, but it cannot release a photon and go to a lower-energy electronic state). However, an electron transition from the ground state to a lower-energy state may be possible by a resonant nonradiative energy transfer such as multipole coupling or a resonant collision mechanism. Processes such as hydrogen molecular bond formation that occur without photons and that require collisions are common [47]. Also, some commercial phosphors are based on resonant nonradiative energy transfer involving multipole coupling [48].
>
> We propose that atomic hydrogen may undergo a catalytic reaction with certain atoms and ions such as He^+ which singly or multiply ionize at integer multiples of the potential energy of atomic hydrogen, $m \cdot 27.2\ eV$ wherein m is an integer. The theory was given previously [49]. The reaction involves a nonradiative energy transfer to form a hydrogen atom that is lower in energy than unreacted atomic hydrogen that corresponds to a fractional principal quantum number. That is
>
> $$n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \ldots, \frac{1}{p}; \quad p \text{ is an integer; } p \le 137 \quad \text{(2c)}$$
>
> replaces the well known parameter $n = \text{integer}$ in the Rydberg equation for hydrogen excited states. Thus, the Rydberg states are extended to lower levels as depicted in Figure 9. The $n = 1$ state of hydrogen and the $n = \frac{1}{\text{integer}}$ states of hydrogen are nonradiative, but a transition between two nonradiative states is possible via a nonradiative energy transfer, say $n = 1$ to $n = 1/2$. Thus, a catalyst provides a net positive enthalpy of reaction of $m \cdot 27.2\ eV$ (i.e. it resonantly accepts the nonradiative energy transfer from hydrogen atoms and releases the energy to the surroundings to affect electronic transitions to fractional quantum energy levels). As a consequence of the nonradiative energy transfer, the hydrogen atom becomes unstable and emits further energy until it achieves a lower-

energy nonradiative state having a principal energy level given by Eqs. (2a) and (2c).

The novel peaks fit two empirical relationships. In order of energy, the set comprising the peaks at $91.2\ nm$, $45.6\ nm$, $30.4\ nm$, $13.03\ nm$, $10.13\ nm$, and $8.29\ nm$ correspond to energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,7,9,11$. In order of energy, the set comprising the peaks at $37.4\ nm$, $20.5\ nm$, and $14.15\ nm$ correspond to energies of $q \cdot 13.6 - 21.21\ eV$ where $q = 4,6,8$. These lines can be explained as electronic transitions to fractional Rydberg states of atomic hydrogen given by Eqs. (2a) and (2c) wherein the catalytic system involves helium ions because the second ionization energy of helium is $54.417\ eV$, which is equivalent to $2 \cdot 27.2\ eV$. In this case, $54.417\ eV$ is transferred nonradiatively from atomic hydrogen to He^+ which is resonantly ionized. The electron decays to the $n = 1/3$ state with the further release of $54.417\ eV$ which may be emitted as a photon. The catalysis reaction is

$$54.417\ eV + He^+ + H[a_H] \rightarrow He^{2+} + e^- + H\left[\frac{a_H}{3}\right] + 108.8\ eV \tag{3}$$

$$He^{2+} + e^- \rightarrow He^+ + 54.417\ eV \tag{4}$$

And, the overall reaction is

$$H[a_H] \rightarrow H\left[\frac{a_H}{3}\right] + 54.4\ eV + 54.4\ eV \tag{5}$$

Since the products of the catalysis reaction have binding energies of $m \cdot 27.2\ eV$, they may further serve as catalysts. Thus, further catalytic transitions may occur: $n = \frac{1}{3} \rightarrow \frac{1}{4}, \frac{1}{4} \rightarrow \frac{1}{5}$, and so on.

Electronic transitions to Rydberg states given by Eqs. (2a) and (2c) catalyzed by the resonant nonradiative transfer of $m \cdot 27.2\ eV$ would give rise to a series of emission lines of energies $q \cdot 13.6\ eV$ where q is an integer. It is further proposed that the photons that arise from hydrogen transitions may undergo inelastic helium scattering. That is, the catalytic reaction

$$H[a_H] \xrightarrow{He^+} H\left[\frac{a_H}{3}\right] + 54.4\ eV + 54.4\ eV \tag{6}$$

yields $54.4\ eV$ by Eq. (4) and a photon of $54.4\ eV$ ($22.8\ nm$). Once emitted, the photon may be absorbed or scattered. When this photon strikes $He\,(1s^2)$, $21.2\ eV$ may be absorbed in the excitation to $He\,(1s^1 2p^1)$. This leaves a $33.19\ eV$ ($37.4\ nm$) photon peak and a $21.21\ eV$ ($58.4\ nm$) photon from $He\,(1s^1 2p^1)$. Thus, for helium the inelastic scattered peak of $54.4\ eV$ photons from Eq. (3) is given by

$$E = 54.4\ eV - 21.21\ eV = 33.19\ eV\ (37.4\ nm) \tag{7}$$

A novel peak shown in Figures 2-4 was observed at $37.4\ nm$. Furthermore, the intensity of the $58.4\ nm$ peak corresponding to the spectra shown in Figure 4 was about 60,000 photons/sec. Thus, the

transition $He\,(1s^2) \rightarrow He\,(1s^1 2p^1)$ dominated the inelastic scattering of EUV peaks. The general reaction is

$$photon\,(h\nu) + He\,(1s^2) \rightarrow He\,(1s^1 2p^1) + photon\,(h\nu - 21.21\ eV) \qquad (8)$$

The two empirical series may be combined—one directly from Eqs. (2a, 2c) and the other indirectly with Eq. (8). The energies for the novel lines in order of energy are $13.6\ eV$, $27.2\ eV$, $40.8\ eV$, $54.4\ eV$, $81.6\ eV$, $95.2\ eV$, $108.8\ eV$, $122.4\ eV$ and $149.6\ eV$. The corresponding peaks are $91.2\ nm$, $45.6\ nm$, $30.4\ nm$, $37.4\ nm$, $20.5\ nm$, $13.03\ nm$, $14.15\ nm$, $10.13\ nm$, and $8.29\ nm$, respectively. Thus, the identified novel lines correspond to energies of $q \cdot 13.6\ eV$, $q = 1,2,3,7,9,11$. or $q \cdot 13.6\ eV$, $q = 4,6,8$ less $21.2\ eV$ corresponding to inelastic scattering of these photons by helium atoms due to excitation of $He\,(1s^2)$ to $He\,(1s^1 2p^1)$. The values of q observed are consistent with those expected based on Eq. (5) and the subsequent autocatalyzed reactions as discussed previously [50]. The broad satellite peak at $44.2\ nm$ show in Figure 2-4 is consistent with the reaction mechanism of a nonradiative transfer to a catalyst followed by emission. There is remarkable agreement between the data and the proposed transitions to fractional Rydberg states and these lines inelastically scattered by helium according to Eq. (8). All other peaks could be assigned to He I, He II, second order lines, or atomic or molecular hydrogen emission. No known lines of helium or hydrogen explain the $q \cdot 13.6\ eV$ related set of peaks.

Section 16

(Purposely omitted)

Section 17a

The Committee also wrongly asserts on page 12 of the Action that:

> Applicant continues to misinterpret quantum mechanics (QM) on pages 109-122 of the present response. These misinterpretations are rebutted in Part II of the attached appendix and have been rebutted in all of the arguments made by the Examiner in the previous Office actions and previous attached appendixes to the Office actions.

Applicant responds to the assertions in Part II in his corresponding Appendix submitted herewith.

Section 17b

The Committee also wrongly asserts on page 12 of the Action that:

> With respect to applicant's arguments on pages 123-127 regarding his calorimetry data and those of the prior art, the Examiner addressed these studies in section 20-22 of the ATTACHMENT in paper #22" and remains unpersuaded by applicant's arguments and criticisms of the prior art studies that contradict his results.

Applicant provided detailed experimental support for his arguments on pages 123-127 of his previous Response. The least the Committee could do is properly consider Applicant's arguments and respond to them. To merely assert that these arguments are unpersuasive without giving reasons further exposes the weakness of the Committee's position.

Section 18

On pages 12-13 of the present Action, the Committee commits further error in asserting that:

> Applicant's arguments on pages 137-141 of the present response with respect to the plasma references cited by the Examiner show that he has seriously misinterpreted the Examiner's statements and that he does not understand the crucial point that the Examiner made in the previous office action regarding applicant's anomalous line broadening data. The Examiner's main point was that microwave plasma experiments containing hydrogen and one of Ar or He do not cause anomalous line broadening in contrast to applicant's data and applicant does not explain why the microwave experiments of Luque and Luggenhoelscher do not cause anomalous line broadening even though hydrogen and Ar or He (H, Ar, and He are regarded as a catalyst in applicant's experiments and theory) are present in the experiments. According to applicant's arguments and his data, a plasma containing Ar and hydrogen would show anomalous line broadening due to the resonance transfer mechanism of Ar with hydrogen but this anomalous lie broadening effect was absent in the microwave experiments of the prior art cited by the Examiner.
>
> It is crucial to note Luque did not observe Ar catalyzing hydrogen atoms in his microwave discharge experiments (that would be evidenced by anomalous line broadening according to applicant's arguments) in direct contrast to applicant's microwave discharge experiments with Ar and hydrogen and applicant does not deny that Luque did not observe anomalous line broadening in his microwave experiments containing Ar and hydrogen.

The Committee's arguments have no merit whatsoever. The broadening in Applicant's work was observed in an Evenson microwave cell that is one of the best known cavities for producing ions required in the case of the hydrino reaction since Ar+ and He+ are the catalyst. The broadening was found to be dependent on time and flow rate that are indicative of a chemical reaction. In contrast, Luque's experiments did not use an Evenson cavity and were not performed with variation the flow rate or run for long duration.

The Committee is changing its story and attributing it to a misunderstanding on the part of Applicant, which is not true. The Committee's position is clear from its prior statement, in which it incorrectly argued that broadening was observed and could be attributed to conventional explanations:

> Applicant points out that the reasons for Balmer line broadening are discussed in many articles, and that the observed broadening is in excess in what can be expected from known sources thereof. This is not persuasive because broadening may be caused by various means including those taken into account by applicant, and those not taken into account. In the enclosed article by Luggenholscher, et. al. , broadening equivalent to that found by applicant, shown in figure 1, is accounted for by conventionally known explanations such as the Stark effect. The enclosed article by Luque et. al. accounts for Halpha broadening using two Lorentzian mechanisms (Stark and Van der Waals) and two Gaussian mechanisms (Doppler and instrumental).

Section 19

The Committee continues to misapprehend the evidence of record as demonstrated by the following arguments on page 13 of the Action:

> Applicant has also seriously misinterpreted the Examiner's plasma arguments by incorrectly comparing the Examiner's cited line broadening of 0.16 nm in the prior art with >100 eV hot H found in applicant's rt-plasmas. Due to applicant's misinterpretation of the Examiner's statements, the data of the prior art and his own data, he incorrectly states that the line broadening observed in Luggenhoelscher is off by six orders of magnitude as compared to applicant's observed line widths on page 169 of the present response. The applicant's misinterpretation of the Examiner's remarks on his plasma data, those of the cited prior art, and his own data are detailed on pages 6-12 of the attached appendix (Part I, section B (subsections d.1-d.6, e, and f)).

Again, Applicant strongly disagrees. A broadening of 0.16 nm corresponds to 10 eV. The observation of such large broadening with a catalyst (Ar+) and hydrogen in a microwave cell confirms Applicant's result. Such broadening can not be explained by the Stark effect or other conventional explanations. Specifically, from 49. R. L. Mills, P. Ray, B. Dhandapani, J. He, "Comparison of Excessive Balmer α Line Broadening of Inductively and Capacitively Coupled RF, Microwave, and Glow Discharge Hydrogen Plasmas with Certain Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. (2003), pp. 338-355:

> Stark broadening of hydrogen lines in plasmas can not be measured at low electron densities using conventional emission or absorption spectroscopy because it is hidden by Doppler broadening. In the case of the Lyman α line, the Stark width exceeds the Doppler width only at $n_e > 10^{17}\ cm^{-3}$ for temperatures of about $10^4\ K$ [34]. Gigosos and Cardenoso [35] give the observed Balmer α Stark broadening for plasmas of hydrogen with helium or argon as a function of the electron temperature and density. For example, the Stark broadening of the Balmer α line recorded on a $H + He^+$ plasma is only 0.033 nm with $T_e = 20{,}000\ K$ and $n_e = 1.4\,X\,10^{14}\ cm^{-3}$.
>
> The relationship between the Stark broadening $\Delta\lambda_S$ of the Balmer β line in nm, the electron density n_e in m^{-3}, and the electron temperature T_e in K is
>
> $$\log n_e = C_0 + C_1 \log(\Delta\lambda_S) + C_2[\log(\Delta\lambda_S)]^2 + C_3 \log(T_e) \tag{5}$$
>
> where $C_0 = 22.578$, $C_1 = 1.478$, $C_2 = -0.144$, and $C_3 = 0.1265$ [36]. From Eq. (5), to get a Stark broadening of only 0.1 nm with $T_e = 9000\ K$, an electron density of about $n_e \sim 3\,X\,10^{15}\ cm^{-3}$ is required, compared to that of the argon-hydrogen plasma of $< 10^9\ cm^{-3}$ determined using a compensated Langmuir probe, over six orders of magnitude less. Regional maxima in electron densities that could give rise to Stark broadening was eliminated as a possibility. The measured electron densities did not exceed $10^9\ cm^{-3}$, and the axial variation was weak, showing less than a factor of two change throughout the brightest region of the plasma. The high mass diffusivity of all of the species present made it unlikely that a large density gradient existed anywhere in the plasma at steady state. This result was also evident by the good fit to a Gaussian profile recorded on the argon-hydrogen plasma rather than a Voigt profile as shown in Figure 10. In addition, the line broadening for Balmer β, γ, and δ was comparable to that of Balmer α; whereas, an absence of broadening beyond the

instrument width was observed for the lines of argon or helium species such as the 667.73 nm and 591.2 nm Ar I lines and 667.816 nm and 587.56 nm He I lines. Thus, the Stark broadening was also insignificant.

A linear Stark effect arises from an applied electric field that splits the energy level with principal quantum number n into $(2n-1)$ equidistant sublevels. The magnitude of this effect given by Videnovic et al. [8] is about $2\,X10^{-2}\ nm/kV\cdot cm^{-1}$. No appreciable applied electric field was present in our study; thus, the linear Stark effect should be negligible. The absence of broadening of the noble gas lines and the hydrogen lines of the controls confirmed the absence of a strong electric field. No charged resonator cavity surfaces were present since the plasmas was contained in a quartz tube with the cavity external to the tube. A microwave E-mode field does exist in the Evenson cavity that is a function of the reflected power [37-38], and the catalysis reaction is dependent on this field as discussed previously [39]. However, there is no cathode fall region and the magnitude of the microwave field is comparably much less than that found in the cathode fall region of a glow discharge cell.

The broadening is unequivocally Doppler broadening as discussed in Reference Nos. 49 and 37. The microwave-field broadening reported in the Committee's cited Luque et al paper is <u>six orders of magnitude too low</u> to account for the broadening reported by Applicant (e.g. Ref. #49).

Specifically, the broadening reported in the Committee's cited reference URL: http://www.phys.tue.nl/FLTPD/Luggenhoelscher.pdf is 0.37 cm-1 with no field and 3.7 cm-1 with the application of the microwave field. The energies corresponding to these widths are $4.5\ X10^{-5}\ eV$ and $4.5\ X10^{-4}\ eV$, respectively, which is absolutely negligible compared to the >10 eV hot H found in rt-plasmas. The microwave field can not explain Applicant's results. The Committee's alternative explanation is off by <u>six orders of magnitude</u>. Thus, the Stark and microwave field effects originally argued by the Committee are eliminated as the basis of the broadening observed in Applicant's cells.

<u>Section 20</u>

The Committee further mistakenly argues on page 13 of the present Action that:

> As explained in Part I of the attached appendix, applicant's assertion of anomalous line broadening in his plasma data due to the resonance transfer (r-t) mechanism is not plausible because there are alternative, conventional explanations for this increased line broadening.

The plasma sheath effect offered by the prior art is a more plausible explanation for the increased line broadening than applicant's rt mechanism involving the postulated hydrino (see E. Kovacevic et al., "The Dynamic Response of the Plasma on the Dust Formation in Ar/C_2H_2 RF Discharges" at http://www.icpig.uni-greifswald.de/proceedings/data/Kovacevic_I and Cvetanovic et al., *J. Appl. Phys.* 97, 033302-1, 2005 that are both cited in the attached appendix).

Applicant measures line broadening in regions were there is no electric field, which eliminates the "plasma sheath" explanation. See 51. **J. Phillips, C-K Chen, R. Mills, "Evidence of catalytic Production of Hot Hydrogen in RF Generated Hydrogen/Argon Plasmas", IEEE Transactions on Plasma Science, submitted.**

J. Phillips, Distinguished National Laboratory Professor at Los Alamos National Laboratory and University of New Mexico, performed verification studies of line broadening in catalysis plasmas. This is the third in a series of papers by our team on apparently anomalous Balmer series line broadening in hydrogen containing RF generated, low pressure (< 600 mTorr) plasmas. In this paper the selective broadening of the atomic hydrogen lines in pure H2 and Ar/H2 mixtures in a large "GEC" cell (36 cm length X 14 cm ID) was mapped as a function of position, H2/Ar ratio, time, power, and pressure. Several observations regarding the selective line broadening were particularly notable as they are unanticipated on the basis of earlier models. First, the anomalous broadening of the Balmer lines was found to exist throughout the plasma, and not just in the region between the electrodes. Second, the broadening was consistently a complex function of the operating parameters particularly gas composition (highest in pure H2) position, power and pressure. Clearly not anticipated by earlier models were the findings that under some conditions the highest concentration of "hot" (>10 eV) hydrogen was found at the entry end, and not in the high field region between the electrodes and that in other conditions, the hottest H was at the (exit) pump (also grounded electrode) end. Third, excitation and electron temperatures were less than one eV in all regions of the plasma not directly adjacent (>1mm) to the electrodes, providing additional evidence that the energy for broadening, contrary to standard models, is not obtained from the field. Fourth, in contrast to our earlier studies of hydrogen/helium and water plasmas, we found that in some conditions 98% of the atomic hydrogen was in the "hot" state throughout the GEC cell. Virtually every operating parameter studied impacted the character of the hot H atom population, and clearly second and third order effects exist, indicating a need for experimental design. Some non-field mechanisms for generating hot hydrogen atoms, specifically those suggested by Mills' CQM model, are outlined.

This paper also evaluates the broadening as a function of angle with respect to the electrode. No relationship is observed, which eliminates the "sheath" explanation. Furthermore, the broadening is essentially independent of the electric field across any sheath as well as being equally observed from all directions and observed in the no-field regions. The "sheath" explanation is eliminated on all possible parameters.

The line broadening is independent of position, but dependent on time as shown in:

95. R. L. Mills, P. Ray, B. Dhandapani, "Excessive Balmer α Line Broadening of Water-Vapor Capacitively-Coupled RF Discharge Plasmas" IEEE Transactions on Plasma Science, submitted.

These observations are characteristic of a chemical reaction, and eliminate the "sheath" explanation. Furthermore, broadening is observed in rt-plasma cells that comprise a filament heater only that serves to heat the catalyst and dissociate molecular hydrogen. There is no strong field as reported in the following papers:

109. R. L. Mills, M. Nansteel, J. He, B. Dhandapani, "Low-Voltage EUV and Visible Light Source Due to Catalysis of Atomic Hydrogen", J. Plasma Physics, submitted.
108. R. L. Mills, J. He, M. Nansteel, B. Dhandapani, "Catalysis of Atomic Hydrogen to New Hydrides as a New Power Source", International Journal of Global Energy Issues (IJGEI), Special Edition in Energy Systems, submitted.
81. R. Mills, P. Ray, B. Dhandapani, W. Good, P. Jansson, M. Nansteel, J. He, A. Voigt, "Spectroscopic and NMR Identification of Novel Hydride Ions in Fractional Quantum Energy States Formed by an Exothermic Reaction of Atomic Hydrogen with Certain Catalysts", European Physical Journal-Applied Physics, Vol. 28, (2004), pp. 83-104.
54. R. L. Mills, P. Ray, "Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Catalysts", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1504-1509.
51. R. Mills, P. Ray, R. M. Mayo, "CW HI Laser Based on a Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Group I Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. 2, (2003), pp. 236-247.
46. R. L. Mills, P. Ray, "Stationary Inverted Lyman Population and a Very Stable Novel Hydride Formed by a Catalytic Reaction of Atomic Hydrogen and Certain Catalysts", Optical Materials, Vol. 27, (2004),

pp. 181-186.
42. R. L. Mills, P. Ray, "A Comprehensive Study of Spectra of the Bound-Free Hyperfine Levels of Novel Hydride Ion $H^{-}(1/2)$, Hydrogen, Nitrogen, and Air", Int. J. Hydrogen Energy, Vol. 28, No. 8, (2003), pp. 825-871.

Section 21

The Committee further argues on pages 13-14 of its Action:

> In the Cvetanovic reference cited in the attached appendix, those of ordinary skill in the art in the plasma field do not agree with the rt mechanism proposed by the applicant to explain the anomalous broadening in the hydrogen Balmer alpha line (see abstract and pages 033302-1 to 033302-2 of the reference). Instead, the reference states that the excessive Balmer alpha line broadening is related to the collisions of the fast hydrogen atoms with molecular hydrogen and can be explained by the conventional collision model (CM).

The Committee's misplaced reliance on Cvetanovic et. al. is extremely troubling since this article appears to be a thinly veiled hatchet-job in an attempt to discredit Applicant. Cvetanovic et. al. propose that the energy required to selectively heat atomic hydrogen to extraordinary temperatures comes from the field acceleration of ionic species. The paper **J. Phillips, C-K Chen, R. Mills, "Evidence of catalytic Production of Hot Hydrogen in RF Generated Hydrogen/Argon Plasmas", IEEE Transactions on Plasma Science, submitted** demonstrates that no model of that type is viable. Broadening existed throughout the plasma, and not only in the region of high fields. In fact, it was found that the nature of the broadening does not correlate to field strength whatsoever. All predictions that orientation of the observer relative to the field will impact the nature of the observed broadening were disproved. For example, observation parallel to the field should yield broad lines that are red or blue shifted, and not symmetric, as a function of the orientation of the observer relative to the cathode. The results were always symmetrical. Also, there is every reason to suggest that the magnitude of the broadening observed perpendicular to the direction of the field should be less than that parallel to the field. It was independent of the viewing direction. Philips et al. provide a data set, remarkably thorough relative to that of previously published work, that shows the shape of the Balmer lines perpendicular to the field,

parallel to the field and in regions with no field are remarkably similar under many conditions. This data also makes all forms of the "field acceleration" models of broadening untenable.

The Cvetanovic article contains some data consistent with the statements made above. For example, in Figure 4 of that article there is data that shows that the broadening of the Ha peak is independent of the orientation of observation relative to the field direction.

Unfortunately, although the data agrees with that collected and reported by Philips et al., the text of the article contains some clear misrepresentations. Specifically, the data regarding the fit of Figure 4c (but notably not that of Figures 4a and 4b) is missing. It also appears to the careful reader that Fig. 4c was printed in a larger format than Figures 4a and 4b, and hence gives the appearance to the casual reader that the broadening in Figure 4c is larger than that of figures 4a and 4b. In fact, the broadening of Figure 4c is virtually identical to that measured for Figures 4a and 4b.

Perhaps the authors of the aforementioned paper did not want readers to have direct access to the data? Indeed, the data contradicts statements made in the Abstract:

> Large excessive Balmer alpha line broadening in pure hydrogen and its dependence upon the direction of observation with respect to the electric field is in contradiction to the resonance transfer model, proposed by Mills et al. in several publications (see, e.g., IEEE Trans. Plasma Sci. 31, 338 2003.)

Putting such a statement in the Abstract is a clear indication of the intent of the authors, i.e. to disprove the RT model despite the data to the contrary. Indeed, since the data they present shows that there is no dependence of line broadening upon the direction of observation with respect to the electric fields, the above statement in the abstract is false. The attack on Applicant's paper thus has the appearance of malice.

The sense of malicious mischief is increased because of additional directly false statements, such as this one from the conclusions:

> The presence of large excessive Ha line broadening in pure hydrogen and several experimental results, such as the importance of the direction of observation with respect to the electric field and exponential decay of excessive broadened

> Balmer line intensity in the negative glow, are in contradiction to the resonance transfer model.5,6

Not only is the data contained in the paper in direct contradiction to the statement regarding "direction of observation", there is in fact not a shred of data presented that refutes any of the predictions of CQM. It is unfortunate that these statements were even published, but then to be touted by the USPTO is outrageous.

Section 22

The Committee further relies improperly on the Cvetanovic et. al. reference in arguing, on page 14 of the Action, that:

> The Cvetanovic reference also states that two independent experiments performed simultaneously in two different laboratories have not been able to reproduce the applicant's excessively broad Balmer line shapes in microwave induced discharge (MIID) experiments (see page 033302-2, left hand column). These laboratories did not detect excessive broadening in the MID experiments. This is contrary to applicant's assertions on page 158 of the present response that the plasma data results have been independently reproduced.

Applicant agrees with the data reported in the Cvetanovic paper that the line energy of the hot H is independent of the direction relative to the electric field, it is symmetrical at all angles and independent of pressure and exists in region of low or no field. The results confirm the catalysis of hydrogen, not field acceleration as the source of the broadened H lines.

It is not clear that Jovicevic et al. failed to observe the phenomenon of fast H in microwave plasmas. In S. Jovicevic, M. Ivkovic, N. Konjevic, S. Popovic, L. Vuskovic, J. Appl. Phys. 95, 24 (2004) the authors state that it impossible to form fast H in microwave plasmas since there is no field which the ions can couple to, but at the conclusion they hedge: "In Ar-H2 discharges, a limited broadening in the wings of the lines coupled be attributed to less than 0.01% fast hydrogen with kinetic energy less than 10 eV". This is very significant given that the electrons heat the atoms and the electron temperature is typically less than 1 eV in these plasmas.

Jovicevic et al used pulsed operation. Others using the same apparatus in

continuous operation, as in the case of Applicant's work and following Applicant's direction regarding the dependence on operating conditions and long duration operation, have reproduced Applicant's results:

44. **A. J. Marchese, P. M. Jansson, J. L. Schmalzel, "The BlackLight Rocket Engine", Phase I Final Report, NASA Institute for Advanced Concepts Phase I, May 1-November 30, 2002, http://www.niac.usra.edu/files/studies/final_report/pdf/752Marchese.pdf.**

Rowan University Professors A. J. Marchese, P. M. Jansson, J. L. Schmalzel performed verification studies as visiting researchers at BlackLight Power, Cranbury, NJ. The prior reported results of BlackLight Power, Inc. of extraordinarily broadened atomic hydrogen lines, population inversion, lower-energy hydrogen lines, and excess power measured by water bath calorimetry were replicated. The application of the energetic hydrogen to propulsion was studied.

Specifically, the data supporting hydrinos was replicated. See

i.) BlackLight Process Theory (pp. 10-12) which gives the theoretical energy levels for hydrinos and the catalytic reaction to form hydrinos,

ii.) Unique Hydrogen Line Broadening in Low Pressure Microwave Water Plasmas (pp. 25-27, particularly Fig. 21) which shows that in the same microwave cavity driven at the same power, the temperature of the hydrogen atoms in the microwave plasma where the hydrino reaction was active was 50 times that of the control based on the spectroscopic line widths,

iii.) Inversion of the Line Intensities in Hydrogen Balmer Series (pp. 27-28, particularly Fig. 22) which shows for the first time in 40 years of intensive worldwide research that atomic hydrogen population inversion was achieved in a steady state plasma and supports the high power released from the reaction of hydrogen to form hydrinos,

iv.) Novel Vacuum Ultraviolet (VUV) Vibration Spectra of Hydrogen Mixture Plasmas (pp. 28-29, particularly Fig. 23) which shows a novel vibrational series of lines in a helium-hydrogen plasmas at energies higher than any known vibrational series and it identically matches the theoretical prediction of 2 squared times the corresponding vibration of the ordinary hydrogen species, and

v.) Water Bath Calorimetry Experiments Showing Increased Heat Generation (pp. 29-30, particularly Fig. 25) that shows that with exactly the same system and same input power, the heating of the water reservoir absolutely measured to 1% accuracy was equivalent to 55 to 62 W with the catalyst-hydrogen mixture compared to 40 W in the control without the possibility of the reaction to form hydrinos.

42. **R. L. Mills, P. C. Ray, R. M. Mayo, M. Nansteel, B. Dhandapani, J. Phillips, "Spectroscopic Study of Unique Line Broadening and Inversion in Low Pressure Microwave Generated Water Plasmas", J. Plasma Phys., in press.**

J. Phillips, Distinguished National Laboratory Professor at Los Alamos National Laboratory and University of New Mexico, performed verification studies as a visiting researcher at BlackLight Power, Cranbury, NJ. It was demonstrated that low pressure (~ 0.2 Torr) water vapor plasmas generated in a 10 mm ID quartz tube with an Evenson microwave cavity show at least two features which are not explained by conventional plasma models. First, significant (> 2.5 Å) hydrogen Balmer α line broadening was recorded, of constant width, up to 5 cm from the microwave coupler. Only hydrogen, and not oxygen, showed significant line broadening. This feature, observed previously in hydrogen-containing mixed gas plasmas generated with high voltage DC and RF discharges was explained by some researchers to result from acceleration of hydrogen ions near the cathode. This explanation cannot apply to the line broadening observed in the (electrodeless) microwave plasmas generated in this work, particularly at distances as great as 5 cm from the microwave coupler. Second, dramatic inversion of the line intensities of both the Lyman and Balmer series, again, at distances up to 5 cm from the coupler were observed. The dramatic line inversion suggests the existence of a hitherto unknown source of pumping of the optical power in plasmas. Finally, it is notable that other aspects of the plasma including the OH^* rotational temperature and low electron concentrations are quite typical of plasmas of this type.

Section 23

The Committee presents further misplaced arguments based on the Cvetanovic et. al. reference, stating on page 14 of the Action:

> As pointed out on page 33302-2 of the Cvetanovic reference, applicant's own plasma results contradict his own theory since his plasma data containing pure H_2 only does not show any anomalous line broadening that is inconsistent with his own theory and argument that two hydrogen atoms (that act as a catalyst) can provide a net enthalpy equal to the potential energy of the hydrogen atom (27.2 eV) which is the necessary resonance energy for a third hydrogen atom. As shown in Figures 6, 8, 12, and 14 of applicant's document entitled "Comparison of Excessive Balmer á Line Broadening of Inductively and Capacitively Coupled RF, Microwave, and Glow Discharge Hydrogen Plasmas with Certain Catalysts" that was submitted to IEEE Transactions on Plasma Science and cited in the information disclosure statement filed on 8/22/2002 in copending case 09/009,837, there is no anomalous line

broadening for microwave plasmas of pure hydrogen alone which contradict applicant's own theory and arguments.

Once again, the Committee fails to comprehend that Cvetanovic et al.'s results and Applicant's results support the CQM theory. The following is the exact self explanatory text from Applicant's IEEE paper:

> The hydrogen atom energy in plasmas of hydrogen mixed with argon or helium were about 50-100 times that observed for the control plasmas such as hydrogen mixed with xenon or hydrogen alone. Even so, the observed $\approx 4\ eV$ energy of the latter plasmas was still well above the resolution capability of the instrument, and surprisingly it was appreciably above that expected based on the electron temperature of 1-2 eV. The observation of an elevated hydrogen atom energy for pure hydrogen plasmas and mixtures containing hydrogen with the unusual absence of an elevated energy of any other gas present has been observed before. For example, using a GEC RF cell Radovanov et al. [12] observed that the structure of the H_α line emission from a pure H_2 discharge showed a slow component with an average energy of 0.2 eV and a broadened component of 8.0 eV. Very high energies have also been observed. Hydrogen line broadening corresponding to 123 eV has been observed with hydrogen plasmas maintained in a GEC RF cell [11]. Extraordinary line broadening near the cathode corresponding to fast H with >300 eV has only been observed in the case of discharges of hydrogen or in hydrogen mixtures. This phenomenon is not observed in discharges of pure noble gases [8, 11, 29-32]. In the case of production of fast H, the intensity may be low due to efficient collisional energy exchange with dissociative excitation of molecular hydrogen [33]. In a glow discharge fast H is formed and excited predominantly near the electrode surfaces. The emission from fast H formed at the cathode is also not expected to extend significantly into the bulk of an H_2 discharge because of quenching of H($n = 3$) by collisions with H_2 [12]. Again, this unusual effect was attributed to electric field acceleration of positive hydrogen ions in the cathode fall region.
>
> In our microwave hydrogen plasma, no such strong field exists. But, the conditions for an rt-plasmas are met. Since the ionization energy of hydrogen is $13.6\ eV$, two hydrogen atoms can provide a net enthalpy equal to the potential energy of the hydrogen atom, 27.2 eV—the necessary resonance energy, for a third hydrogen atom. On this basis, the unusual observation of the H energy slightly above the electron temperature is expected. The effect is expected to be more pronounced at higher greater hydrogen concentrations such as those produced near or on the cathode in RF and glow discharge cells.

Section 24

Finally, the Committee argues on pages 14-15 of the Action:

> Thus, in view of the serious flaws in applicant's theoretical foundation for his invention, the lack of independent, reproducible experiments to verify the existence of the hydrino atom, and the lack of conventional acceptance of the existence of the hydrino atom which is contrary to the accepted scientific theory of the hydrogen atom, applicant has failed to provide preponderance of evidence to support his claims.

The scientific evidence presented by Applicant, as well as his detractors, supports Applicant's theory in refutation of the erroneous position taken by the Committee. The data clearly indicate that the selective extraordinary H broadening in only those plasmas that contain hydrogen and a suitable catalyst can not be explained by field acceleration, but are absolutely consistent with the predictions of CQM and the formation of hydrinos.

The Committee has refused to properly consider this compelling scientific evidence based on its adoption of the biased views espoused by Examiner Souw in his Appendix. Applicant appeals once again to the Committee to reconsider its tenuous position and to allow the present application to issue.

Conclusion

For the foregoing reasons, Applicant respectfully submits that the subject application fully satisfies the legal requirements of 35 U.S.C. §§ 101 and 112, first paragraph, and is therefore in condition for allowance. A Notice to that affect is earnestly solicited.

Respectfully submitted,
Manelli, Denison & Selter, PLLC

By ____________

Jeffrey S. Melcher
Reg. No.: 35,950
Tel. No.: 202.261.1045
Fax. No.: 202.887.0336

Customer No. 20736

Journal and Book Publications

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54. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics Workshop", at the University of Eindhoven, Netherlands, February 28, 2005.
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49. B. Dhandapani, R. Mills, “Novel Liquid-Nitrogen-Condensable Molecular Hydrogen Gas” (Physical Chemistry Session) , Wednesday, June 11, 2003, 36th Middle Atlantic Regional Meeting of American Chemical Society, (June 8–11, 2003), Princeton University, Princeton, NJ.
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27. P. Ray, R. Mills, "Spectroscopic identification of a novel catalytic reaction of hydrogen plasma", Session ET1: Lighting, American Physical Society Meeting, 54th Annual Gaseous Electronics Conference, October 9–12, 2001, Pennsylvania State University, State College, PA.
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25. R. Mills, "Spectroscopic identification of a novel catalytic reaction of hydrogen", Division of Inorganic Chemistry; Session: Catalysis, 222nd American Chemical Society Fall National Meeting, (August 26–30, 2001), Chicago, IL.
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15. R. Mills, J. He, and B. Dhandapani, "Novel Alkali and Alkaline Earth Hydrides", August National ACS Meeting (220th ACS National Meeting, Washington, DC, (August 20-24, 2000)).
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13. Mills, J. Dong, N. Greenig, and Y. Lu, "Observation of Extreme Ultraviolet Hydrogen Emission from Incandescently Heated Hydrogen Gas with Certain Catalysts", 219 th National ACS Meeting, San Francisco, California, (March 26-30, 2000).

12. R. Mills, B. Dhandapani, N. Greenig, J. He, J. Dong, Y. Lu, and H. Conrads, "Formation of an Energetic Plasma and Novel Hydrides from Incandescently Heated Hydrogen Gas with Certain Catalysts", 219 th National ACS Meeting, San Francisco, California, (March 26-30, 2000).
11. R. Mills, "Novel Hydride Compound", 219 th National ACS Meeting, San Francisco, California, (March 26-30, 2000).
10. R. Mills, J. He, and B. Dhandapani, "Novel Alkali and Alkaline Earth Hydrides", 219 th National ACS Meeting, San Francisco, California, (March 26-30, 2000).
9. R. Mills, J. Dong, N. Greenig, and Y. Lu, "Observation of Extreme Ultraviolet Hydrogen Emission from Incandescently Heated Hydrogen Gas with Certain Catalysts", National Hydrogen Association, 11 th Annual U.S. Hydrogen Meeting, Vienna, VA, (February 29-March 2, 2000).
8. R. Mills, B. Dhandapani, N. Greenig, J. He, J. Dong, Y. Lu, and H. Conrads, "Formation of an Energetic Plasma and Novel Hydrides from Incandescently Heated Hydrogen Gas with Certain Catalysts", National Hydrogen Association, 11 th Annual U.S. Hydrogen Meeting, Vienna, VA, (February 29-March 2, 2000).
7. R. Mills, "Novel Hydride Compound", National Hydrogen Association, 11 th Annual U.S. Hydrogen Meeting, Vienna, VA, (February 29-March 2, 2000).
6. R. Mills, J. He, and B. Dhandapani, "Novel Alkali and Alkaline Earth Hydrides", National Hydrogen Association, 11 th Annual U.S. Hydrogen Meeting, Vienna, VA, (February 29-March 2, 2000).
5. R. Mills, J. Dong, Y. Lu, J. Conrads, "Observation of Extreme Ultraviolet Hydrogen Emission from Incandescently Heated Hydrogen Gas with Certain Catalysts", 1999 Pacific Conference on Chemistry and Spectroscopy and the 35th ACS Western Regional Meeting, Ontario Convention Center, California, (October 6-8, 1999).
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1. R. Mills, "Excess Heat Production by the Electrolysis of an Aqueous Potassium Carbonate Electrolyte", August 1991 meeting of the American Chemical Society, NY, NY.

APPENDIX

Response to Bernard E. Souw Appendix Attached to February 102005 Final Office Action in U.S. App'n Ser. No. 09/009,837

The anonymous group of PTO officials and other unknown members that constitute the Secret Committee responsible for handling this and other BlackLight applications have relied heavily on arguments presented by Examiner Souw in various Appendices attached to previous Office Actions. Applicant responded by filing his own Appendices that raised points discrediting those arguments and further highlighting the Committee's failure to seriously consider Applicant's scientific evidence proving the existence of lower-energy hydrogen. Many of those points stand unrebutted and, therefore, weigh heavily in favor of allowing the pending claims in this case to issue.

In an attempt to counter a few of those points, the Committee now responds with additional arguments presented by Examiner Souw in yet another Appendix attached to the present Advisory Action, which still does little to advance the prosecution of this application. [Souw Appendix IV] To the contrary, these newly presented arguments expose an even greater disregard for Applicant's scientific evidence, in which Examiner Souw: (1) misstates proper standards for evaluating that evidence, thereby unfairly creating new standards; (2) misinterprets experimental data (even misreading a simple figure); and (3) misunderstands basic scientific concepts resulting in the improper invalidation of Applicant's evidence, such as his XPS and water bath calorimetry data.

Applicant's discussion herein tracks all of these arguments and rebuts them point by point, calling into question the extent to which his scientific evidence has received a fair hearing. From this discussion, it is clear that the Examiner, unable to refute that evidence on scientific grounds, resorts to mere hand waving to dismiss the data.[1]

Section 25

[1] In each of the Sections below, the language quoted from Examiner's Souw's Appendix may contain typographical errors in regards to the formulae. Thus, when in doubt as to the correct formulae, please refer to the original text of his Attachment.

In the Section of Examiner Souw's Appendix entitled "I. Experimental Part," under "(A) General Arguments" the Examiner begins on page 1 by claiming:

> Applicant's alleged "evidence" falls into three categories:
>
> (a) Those published by Applicant himself, his own company Blacklight Power Inc. (hereinafter BLP) and/or its subsidiaries, including companies paid by BLP to do work on BLP's behalf, all of which report results which are in contradiction to those obtained by independent third parties. In this regard, **all** attempts carried out by independent third parties to reproduce Applicant's claimed results have failed [1, 2]. Thus, Applicant's publications of this category are not considered as supports for the patentability of the present invention, since their results are deemed incredible. Falling under this category are publications nos. 7, 13-15 (sponsored by BLP), 17, 20-43 and 46-47.

As given in Section Nos. 20-24 of Applicant's main response, the results of Cvetanovic and possibly the results of Jovicevic et al. actually confirm Applicant's results. Furthermore, it is absurd to imply that the very prestigious researchers and research institutions that are listed in the 51 independent validations provide in the section entitled "Independent Test Results" are falsifying data or providing misleading statements. The only evidence of such is that of the detractors as given in Section 21 of Applicant's main response.

Section 26

The second evidentiary category identified by Examiner Souw on page 1 of his Appendix is:

> (b) Those published in non-peer-reviewed journals, as already identified in previous Office Action(s)

Applicant's results are published in over 60 peer-reviewed journal articles and the remaining are expected to be published as well. The Examiner's refusal to recognize this fact merely confirms his bias, as discussed at length in Applicant's main response.

Section 27

The third and final evidentiary category identified by Examiner Souw on page 2 of his Appendix is:

> (c) Those claiming observations unrelated and/or irrelevant to hydrino, such as excessive line broadening, novel peaks (either plasma or solid state spectroscopy), excess heat, enhanced radiation, i.e., phenomena explainable by conventional physics (e.g., impurities that evidently disappeared after surface cleaning [3]), while totally lacking any hard evidence (such as material hardness measurement), as already identified in previous Office Actions. To this category belong publications nos. 1-6, 8-12, 16, 18-19, 44, and 45.

Here again, the Examiner shows his bias. All of the results presented by Applicant confirm his technology.

Excessive line broadening cannot be explained by conventional methods, such as field acceleration, and demonstrates the energetic reaction of hydrogen to lower-energy states. See:

51. J. Phillips, C-K Chen, R. Mills, "Evidence of catalytic Production of Hot Hydrogen in RF Generated Hydrogen/Argon Plasmas", IEEE Transactions on Plasma Science, submitted.
109. R. L. Mills, M. Nansteel, J. He, B. Dhandapani, "Low-Voltage EUV and Visible Light Source Due to Catalysis of Atomic Hydrogen", J. Plasma Physics, submitted.
108. R. L. Mills, J. He, M. Nansteel, B. Dhandapani, "Catalysis of Atomic Hydrogen to New Hydrides as a New Power Source", International Journal of Global Energy Issues (IJGEI), Special Edition in Energy Systems, submitted.
81. R. Mills, P. Ray, B. Dhandapani, W. Good, P. Jansson, M. Nansteel, J. He, A. Voigt, "Spectroscopic and NMR Identification of Novel Hydride Ions in Fractional Quantum Energy States Formed by an Exothermic Reaction of Atomic Hydrogen with Certain Catalysts", European Physical Journal-Applied Physics, Vol. 28, (2004), pp. 83-104.
54. R. L. Mills, P. Ray, "Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Catalysts", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1504-1509.
51. R. Mills, P. Ray, R. M. Mayo, "CW HI Laser Based on a Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Group I Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. 2, (2003), pp. 236-247.
49. R. L. Mills, P. Ray, B. Dhandapani, J. He, "Comparison of Excessive Balmer α Line Broadening of Inductively and Capacitively Coupled RF, Microwave, and Glow Discharge Hydrogen Plasmas with Certain Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. 3, (2003), pp. 338-355.
46. R. L. Mills, P. Ray, "Stationary Inverted Lyman Population and a Very Stable Novel Hydride Formed by a Catalytic Reaction of Atomic Hydrogen and Certain Catalysts", Optical Materials, Vol. 27, (2004), pp. 181-186.

42. R. L. Mills, P. Ray, "A Comprehensive Study of Spectra of the Bound-Free Hyperfine Levels of Novel Hydride Ion $H^-(1/2)$, Hydrogen, Nitrogen, and Air", Int. J. Hydrogen Energy, Vol. 28, No. 8, (2003), pp. 825-871.

Novel peaks (either plasma or solid state spectroscopy) show the energy levels of hydrino directly. See:

112. R. L. Mills, J. He, Y. Lu, M. Nansteel, Z. Chang, B. Dhandapani, "Comprehensive Identification and Potential Applications of New States of Hydrogen", Central European Journal of Physics, submitted.
111. R. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrogen Species $H^-(1/4)$ and $H_2(1/4)$ as a New Power Source", Thermochimica Acta, submitted.
110. R. L. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrides as a New Power Source," Prepr. Pap.-Am. Chem. Soc., Div. Fuel Chem. 2005, 50(2).
67. R. L. Mills, P. Ray, "Extreme Ultraviolet Spectroscopy of Helium-Hydrogen Plasma", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542.

Excess heat-direct measurement of the enthalpy of formation of hydrinos and can not be explained by conventional chemistry. See:

77. J. Phillips, R. L. Mills, X. Chen, "Water Bath Calorimetric Study of Excess Heat in 'Resonance Transfer' Plasmas", Journal of Applied Physics, Vol. 96, No. 6, pp. 3095-3102.

"Enhanced radiation" with over 1000 times more light is observed for power input than in a conventional light source, which confirms the power source of the catalysis of hydrogen to lower-energy states. See:

52. R. Mills and M. Nansteel, P. Ray, "Bright Hydrogen-Light Source due to a Resonant Energy Transfer with Strontium and Argon Ions", New Journal of Physics, Vol. 4, (2002), pp. 70.1-70.28.
20. R. Mills and M. Nansteel, P. Ray, "Argon-Hydrogen-Strontium Discharge Light Source", IEEE Transactions on Plasma Science, Vol. 30, No. 2, (2002), pp. 639-653.
16. R. Mills, M. Nansteel, and P. Ray, "Excessively Bright Hydrogen-Strontium Plasma Light Source Due to Energy Resonance of Strontium with Hydrogen", J. of Plasma Physics, Vol. 69, (2003), pp. 131-158.

Examiner Souw's comment that Applicant's observations are simply "phenomena explainable by conventional physics (e.g., impurities that evidently disappeared after surface cleaning [3])," has no basis. As Applicant has demonstrated, conventional physics can not explain these observations

Similarly, the Examiner's further statement claiming that Applicant's observations are "totally lacking any hard evidence (such as material hardness measurement), as already identified in previous Office Actions," also lacks merit. Applicant has provided data on novel properties, such as extraordinary stability to oxidation

61. R. L. Mills, B. Dhandapani, J. He, "Highly Stable Amorphous Silicon Hydride", Solar Energy Materials & Solar Cells, Vol. 80, No. 1, (2003), pp. 1-20.

and behavior of hydrides as organic molecules in chromatographic analysis and extraordinary stability in water:

38. R. Mills, E. Dayalan, P. Ray, B. Dhandapani, J. He, "Highly Stable Novel Inorganic Hydrides from Aqueous Electrolysis and Plasma Electrolysis", Electrochimica Acta, Vol. 47, No. 24, (2002), pp. 3909-3926.
10. R. Mills, B. Dhandapani, N. Greenig, J. He, "Synthesis and Characterization of Potassium Iodo Hydride", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1185-1203.
9. R. Mills, "Novel Inorganic Hydride", Int. J. of Hydrogen Energy, Vol. 25, (2000), pp. 669-683.
8. R. Mills, B. Dhandapani, M. Nansteel, J. He, T. Shannon, A. Echezuria, "Synthesis and Characterization of Novel Hydride Compounds", Int. J. of Hydrogen Energy, Vol. 26, No. 4, (2001), pp. 339-367.

Further, the relationship of the data to hydrino validation is given in the section entitled "Lower-Energy Hydrogen Experimental Data".

Section 28

On page 2 of the Appendix, Examiner Souw draws the outrageous comparison of Applicant's invention to "crop circles," which statements Applicant requests be stricken from the record:

The Examiner's rejection of "evidences" of category (a) to (c) remains the same, and is summarized as follows:

> **(A.1)** Peculiarity or anomaly alone is by far not sufficient as "evidence". There are a great abundance of peculiarities and anomalies in this world, from "irreducibly complex molecular machines" to "**crop circles**". Many are hoaxes, and some are genuine phenomena waiting to be resolved by true science. However, hydrino is here excluded as a possible cause for the peculiarities and anomalies presented on pgs. 1-37, not only because there is no evidence for its existence, but additionally, because the underlying theory, the Grand Unified Theory of Classical Quantum Mechanics, hereinafter GUT, has now been proven totally invalid as a scientific theory (see part II of this Appendix) owing to the incredibly large number of mathematical flaws and violations of known physical laws. There are still many plausible causes instead of the incredible hydrino that may be responsible for the peculiarities and anomalies cited in Applicant papers listed on pgs. 1-37, a few of which have been discussed in previous Office Action(s) and will be consequently prosecuted in the following sections. [Emphasis added.]

Perhaps "crop circles" and hoaxes are high on Examiner Souw's mind since they are akin to aspects of SQM upon which his world view is based and provides the framework (or lack there of) for the interpretation of the real-world evidence provided by Applicant. The Examiner has the theory issue directly reversed. Quantum mechanics involves "spooky actions," virtual particles in every point in space, infinities, polarization of the vacuum, lack of Einstein causality, negative kinetic energy states including infinite ones, paradoxes, mysteries, postulates, and enigmas. It has as its parameter Psi, which has no physical basis.

In stark contrast, Applicant's work is based on applying Maxwell's equations and Newtonian mechanics as well as special relativity to solve atomic problems. The results of closed-form equations with fundamental constants only that match 100's of observables can not be matched by SQM, which is merely a non predictive exercise in curve fitting with computers. Furthermore, the data presented by Applicant overwhelmingly confirms hydrino by direct spectral identification and by the identification of the conjugate observables associated with its formation.

Results include confirmation by at least 11 different techniques that are all showing different aspects of the same thing: a powerful reaction of atomic hydrogen and the formation of hydrino. These include: (1) a match between the catalysts and the observed emission for the hydrino reaction, (2) signatures of energetic reactions, including extraordinarily hot hydrogen atoms, the predicted formation of plasma, and

energetic pumping (excitation) of hydrogen states, (3) large heat of the formation of hydrino, (4) the spectral emission of lower-energy hydrogen atoms, (5) the spectral emission from vibration and rotation of the hydrino molecule, (6) the observation of the corresponding hydrino hydride ion by emission spectroscopy that can not be assigned to any known species, (7) the predicted NMR signature from the hydride ion and the corresponding gas molecule, (8) the binding energy of the molecule and the hydride ion measured by mass spectroscopy and X-ray photoelectron spectroscopy, respectively, (9) the rotational emission of the molecules trapped in the hydride compounds with electron-beam excitation, (10) the isolation and characterization of chemical compounds containing the new hydrides ions that show extraordinary properties and analytical signatures, and most significantly, (11) the exact spectrum predicted for the single-rotational transition of hydrino molecules trapped in the solid compounds. The energies, intensities, line widths, and peak spacing match theory identically, and the results match the body of other evidence from independent techniques. A summary is given in the section entitled "Lower-Energy Hydrogen Experimental Data".

See Applicant's papers such as:

111. R. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrogen Species $H^-(1/4)$ and $H_2(1/4)$ as a New Power Source", Thermochimica Acta, submitted.

ABSTRACT

The data from a broad spectrum of investigational techniques strongly and consistently indicates that hydrogen can exist in lower-energy states then previously thought possible. The predicted reaction involves a resonant, nonradiative energy transfer from otherwise stable atomic hydrogen to a catalyst capable of accepting the energy. The product is $H(1/p)$, fractional Rydberg states of atomic hydrogen wherein $n=\frac{1}{2},\frac{1}{3},\frac{1}{4},\ldots,\frac{1}{p}$; ($p \leq 137$ is an integer) replaces the well known parameter $n = \text{integer}$ in the Rydberg equation for hydrogen excited states. He^+, Ar^+, and K are predicted to serve as catalysts since they meet the catalyst criterion—a chemical or physical process with an enthalpy change equal to an integer multiple of the potential energy of atomic hydrogen, $27.2\ eV$. Specific predictions based on closed-form equations for energy levels were tested. For example, two $H(1/p)$ may react to form $H_2(1/p)$

that have vibrational and rotational energies that are p^2 times those of H_2 comprising uncatalyzed atomic hydrogen. Rotational lines were observed in the 145-300 nm region from atmospheric pressure electron-beam excited argon-hydrogen plasmas. The unprecedented energy spacing of 4^2 times that of hydrogen established the internuclear distance as 1/4 that of H_2 and identified $H_2(1/4)$.

The predicted products of alkali catalyst K are $H^-(1/4)$ which form $KH*X$, a novel alkali halido (X) hydride compound, and $H_2(1/4)$ which may be trapped in the crystal. The ^1H MAS NMR spectrum of novel compound $KH*Cl$ relative to external tetramethylsilane (TMS) showed a large distinct upfield resonance at -4.4 ppm corresponding to an absolute resonance shift of -35.9 ppm that matched the theoretical prediction of $H^-(1/p)$ with p = 4. The predicted frequencies of ortho and para-$H_2(1/4)$ were observed at 1943 cm^{-1} and 2012 cm^{-1} in the high resolution FTIR spectrum of $KH*I$ having a -4.6 ppm NMR peak assigned to $H^-(1/4)$. The 1943/2012 cm^{-1}-intensity ratio matched the characteristic ortho-to-para-peak-intensity ratio of 3:1, and the ortho-para splitting of 69 cm^{-1} matched that predicted. $KH*Cl$ having $H^-(1/4)$ by NMR was incident to the 12.5 keV electron-beam which excited similar emission of interstitial $H_2(1/4)$ as observed in the argon-hydrogen plasma. KNO_3 and Raney nickel were used as a source of K catalyst and atomic hydrogen, respectively, to produce the corresponding exothermic reaction. The energy balance was $\Delta H = -17,925\ kcal/mole\ KNO_3$, about 300 times that expected for the most energetic known chemistry of KNO_3, and $-3585\ kcal/mole\ H_2$, over 60 times the hypothetical maximum enthalpy of $-57.8\ kcal/mole\ H_2$ due to combustion of hydrogen with atmospheric oxygen, assuming the maximum possible H_2 inventory. The reduction of KNO_3 to water, potassium metal, and NH_3 calculated from the heats of formation only releases $-14.2\ kcal/mole\ H_2$ which can not account for the observed heat; nor can hydrogen combustion. But, the results are consistent with the formation of $H^-(1/4)$ and $H_2(1/4)$ having enthalpies of formation of over 100 times that of combustion.

<u>Section 29</u>

On page 2 of his Appendix, Examiner Souw erroneously summarizes Applicant's scientific evidence as follows:

> To summarize, Applicant's results are either (a) disproved by independent third party researchers (e.g., Marchese et al. [1] and EarthTech [2]; see B.3(c) below), or (b) explained by others as being due to causes other

than hydrino (e.g., Fan et al. [3] and Luggenhoelscher [see previous Appendix]).

Marchese et al. validated Applicant's results as reported :

44. **A. J. Marchese, P. M. Jansson, J. L. Schmalzel, "The BlackLight Rocket Engine", Phase I Final Report, NASA Institute for Advanced Concepts Phase I, May 1-November 30, 2002, http://www.niac.usra.edu/files/studies/final_report/pdf/752Marchese.pdf.**

Rowan University Professors A. J. Marchese, P. M. Jansson, J. L. Schmalzel performed verification studies as visiting researchers at BlackLight Power, Cranbury, NJ. The prior reported results of BlackLight Power, Inc. of extraordinarily broadened atomic hydrogen lines, population inversion, lower-energy hydrogen lines, and excess power measured by water bath calorimetry were replicated. The application of the energetic hydrogen to propulsion was studied.

Specifically, the data supporting hydrinos was replicated. See

i.) BlackLight Process Theory (pp. 10-12) which gives the theoretical energy levels for hydrinos and the catalytic reaction to form hydrinos,

ii.) Unique Hydrogen Line Broadening in Low Pressure Microwave Water Plasmas (pp. 25-27, particularly Fig. 21) which shows that in the same microwave cavity driven at the same power, the temperature of the hydrogen atoms in the microwave plasma where the hydrino reaction was active was 50 times that of the control based on the spectroscopic line widths,

iii.) Inversion of the Line Intensities in Hydrogen Balmer Series (pp. 27-28, particularly Fig. 22) which shows for the first time in 40 years of intensive worldwide research that atomic hydrogen population inversion was achieved in a steady state plasma and supports the high power released from the reaction of hydrogen to form hydrinos,

iv.) Novel Vacuum Ultraviolet (VUV) Vibration Spectra of Hydrogen Mixture Plasmas (pp. 28-29, particularly Fig. 23) which shows a novel vibrational series of lines in a helium-hydrogen plasmas at energies higher than any known vibrational series and it identically matches the theoretical prediction of 2 squared times the corresponding vibration of the ordinary hydrogen species, and

v.) Water Bath Calorimetry Experiments Showing Increased Heat Generation (pp. 29-30, particularly Fig. 25) that shows that with exactly the same system and same input power, the heating of the water reservoir absolutely measured to 1% accuracy was equivalent to 55 to 62 W with the catalyst-hydrogen mixture compared to 40 W in the control without the possibility of the reaction to form hydrinos.

EarthTech is also Applicant's competitor; so, their results can not be considered without bias. Many other independent laboratories including INEL, NASA Lewis, MIT Lincoln Labs, Chalk River, and other have validated Applicant's experiments (See the section entitled "Independent Test Results") that were attempted unsuccessfully by EarthTech, which shows that the failure rests on EarthTech, not Applicant's technology.

Regarding Luggenhoelscher, the Examiner is confused. He can not have it both ways by claiming that Luggenhoelscher data does not show an effect as stated in Section 18 of Applicant's main response and here he says that Luggenhoelscher does show line broadening that can be due to some other explanation. The Souw Appendix is full of internal inconsistencies like these, which render the Examiner's analysis null and void.

Section 30

Examiner Souw demonstrates further confusion by arguing on page 3 of the Appendix that:

> Specifically responding to Applicant's statement on pg.17, it is not the Examiner's duty or responsibility to present any alternative explanation; it is sufficient to show that the observed anomaly cannot be due to "hydrino". It is the Examiner's duty and responsibility to reject any mechanism that is scientifically impossible, such as the hypothetical effects due to "hydrino", since there is no evidence that "hydrino" exists, and furthermore, its existence has been proven scientifically impossible. Such a rejection is made possible by the MPEP under 35 U.S.C. § 101 and §112/¶.1.

This statement has no credibility given the evidence summarized in Section 2 of Applicant's main response and Section 28 above. Examiner Souw's statement of "proven scientifically impossible" is not supported by any physical argument since of course energy is released if the electron transitions to an orbit closer to the nucleus. The Examiner is only left with the absence of the prior discovery and unfound theoretical arguments as described in Sections 1-4 of Applicant's main response. The latter is probably responsible for the former.

Section 31

The Examiner continues his biased analysis of Applicant's evidence by stating on page 3 of the Appendix:

> **(A.2)** Applicant's "evidence" is unpersuasive, because NONE of them is hard evidence, but all are invariably argued over some anomalies, such as excessive line broadening, anomalous peaks (in either plasma or solid state spectroscopy), excess heat, enhanced radiation, etc., which do not count, and hence, unpersuasive.

Applicant's experimental evidence provides direct identification of lower-energy hydrogen, with many conjugate parameters, as discussed in Section 2 of Applicant's main response and in Sections 27-28 above.

Section 32

Examiner Souw attempts to further disparage Applicant's evidence on page 3 of the Appendix, but succeeds only in revealing his own analytical shortcomings in the process:

> Regarding evidence, a claim of strong bonding must be validated by <u>measurement of material hardness</u>, but not through unpersuasive arguments over <u>peculiar lines that are irrelevant for being hardly above the noise level</u>, as done by Applicant.

The Examiner's position is nonsensical. Nitrogen, for example, has a very high bond energy, but is not hard. Applicant has measured the bonding in lower-energy hydrogen by the "gold standard," vibration-rotational spectroscopy. See

112. **R. L. Mills, J. He, Y. Lu, M. Nansteel, Z. Chang, B. Dhandapani, "Comprehensive Identification and Potential Applications of New States of Hydrogen", Central European Journal of Physics, submitted.**

> The data from a broad spectrum of investigational techniques strongly and consistently indicates that hydrogen can exist in lower-energy states then previously thought possible. Novel emission lines with energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,11$ were previously observed by extreme ultraviolet (EUV) spectroscopy recorded on microwave discharges of helium with 2% hydrogen [R. L. Mills, P. Ray, J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542]. These lines matched $H(1/p)$, fractional Rydberg states of atomic hydrogen wherein $n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \ldots, \frac{1}{p}$; ($p \leq 137$ is an integer) replaces the well known

parameter n = integer in the Rydberg equation for hydrogen excited states. Evidence supports that these states are formed by a resonant nonradiative energy transfer to He^+ acting as a catalyst. Ar^+ and K also serve as catalysts since, like He^+, they meet the catalyst criterion—a chemical or physical process with an enthalpy change equal to an integer multiple of the potential energy of atomic hydrogen, $27.2\ eV$.

Two $H(1/p)$ may react to form $H_2(1/p)$ that have vibrational and rotational energies that are p^2 times those of H_2 comprising uncatalyzed atomic hydrogen. Rotational lines were observed in the 145-300 nm region from atmospheric pressure electron-beam excited argon-hydrogen plasmas. The unprecedented energy spacing of 4^2 times that of hydrogen established the internuclear distance as 1/4 that of H_2 and identified $H_2(1/4)$. The predicted products of alkali catalyst K are $H^-(1/4)$ which form a novel alkali halido hydride compound ($MH*X$) and $H_2(1/4)$ which may be trapped in the crystal. The ^1H MAS NMR spectrum of novel compound $KH*Cl$ relative to external tetramethylsilane (TMS) showed a large distinct upfield resonance at -4.4 ppm corresponding to an absolute resonance shift of -35.9 ppm that matched the theoretical prediction of $H^-(1/p)$ with p = 4. The predicted catalyst reactions, position of the upfield-shifted NMR peaks for $H^-(1/4)$, and spectroscopic data for $H^-(1/4)$ were found to be in agreement with the experimental observations as well as previously reported analysis of $KH*Cl$ containing this hydride ion.

The predicted frequencies of ortho and para-$H_2(1/4)$ were observed at 1943 cm^{-1} and 2012 cm^{-1} in the high resolution FTIR spectrum of $KH*I$ having a -4.6 ppm NMR peak assigned to $H^-(1/4)$. The 1943/2012 cm^{-1}-intensity ratio matched the characteristic ortho-to-para-peak-intensity ratio of 3:1, and the ortho-para splitting of 69 cm^{-1} matched that predicted. $KH*Cl$ having $H^-(1/4)$ by NMR was incident to the 12.5 keV electron-beam which excited similar emission of interstitial $H_2(1/4)$ as observed in the argon-hydrogen plasma. $H_2(1/p)$ gas was isolated by liquefaction of plasma gas at liquid nitrogen temperature and by decomposition of compounds ($MH*X$) found to contain the corresponding hydride ions $H^-(1/p)$. The $H_2(1/p)$ gas was dissolved in $CDCl_3$ and characterized by ^1H NMR. Considering solvent effects, singlet peaks upfield of H_2 were observed with a predicted integer spacing of 0.64 ppm at 3.47, 3.02, 2.18, 1.25, 0.85, and 0.22 ppm which matched the consecutive series $H_2(1/2)$, $H_2(1/3)$, $H_2(1/4)$, $H_2(1/5)$, $H_2(1/6)$, and $H_2(1/7)$, respectively.

Excess power was absolutely measured from the helium-hydrogen plasma. For an input of 41.9 W, the total plasma power of the helium-hydrogen plasma measured by water bath calorimetry was 62.1 W corresponding to 20.2 W of excess power in 3 cm^3 plasma volume. The excess power density and energy balance were high, $6.7\ W/cm^3$ and $-5.4\ X10^4\ kJ/mole\ H_2$ ($280\ eV/H\ atom$), respectively. In addition to power applications, battery and propellant reactions are proposed that may be transformational, and observed excited vibration-rotational levels of $H_2(1/4)$ could be the basis of a UV laser that could significantly advance photolithography.

111. **R. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrogen Species $H^-(1/4)$ and $H_2(1/4)$ as a New Power Source", Thermochimica Acta, submitted.**

The data from a broad spectrum of investigational techniques strongly and consistently indicates that hydrogen can exist in lower-energy states then previously thought possible. The predicted reaction involves a resonant, nonradiative energy transfer from otherwise stable atomic hydrogen to a catalyst capable of accepting the energy. The product is $H(1/p)$, fractional Rydberg states of atomic hydrogen wherein $n=\frac{1}{2},\frac{1}{3},\frac{1}{4},...,\frac{1}{p}$; ($p \leq 137$ is an integer) replaces the well known parameter $n = \text{integer}$ in the Rydberg equation for hydrogen excited states. He^+, Ar^+, and K are predicted to serve as catalysts since they meet the catalyst criterion—a chemical or physical process with an enthalpy change equal to an integer multiple of the potential energy of atomic hydrogen, $27.2\ eV$. Specific predictions based on closed-form equations for energy levels were tested. For example, two $H(1/p)$ may react to form $H_2(1/p)$ that have vibrational and rotational energies that are p^2 times those of H_2 comprising uncatalyzed atomic hydrogen. Rotational lines were observed in the 145-300 nm region from atmospheric pressure electron-beam excited argon-hydrogen plasmas. The unprecedented energy spacing of 4^2 times that of hydrogen established the internuclear distance as 1/4 that of H_2 and identified $H_2(1/4)$.

The predicted products of alkali catalyst K are $H^-(1/4)$ which form $KH*X$, a novel alkali halido (X) hydride compound, and $H_2(1/4)$ which may be trapped in the crystal. The ^1H MAS NMR spectrum of novel compound $KH*Cl$ relative to external tetramethylsilane (TMS) showed a large distinct upfield resonance at -4.4 ppm corresponding to an absolute resonance shift of -35.9 ppm that matched the theoretical prediction of $H^-(1/p)$ with $p = 4$. The predicted frequencies of ortho and para-$H_2(1/4)$ were observed at 1943 cm^{-1} and 2012 cm^{-1} in the high resolution FTIR

spectrum of $KH*I$ having a -4.6 ppm NMR peak assigned to $H^-(1/4)$. The 1943/2012 cm^{-1}-intensity ratio matched the characteristic ortho-to-para-peak-intensity ratio of 3:1, and the ortho-para splitting of 69 cm^{-1} matched that predicted. $KH*Cl$ having $H^-(1/4)$ by NMR was incident to the 12.5 keV electron-beam which excited similar emission of interstitial $H_2(1/4)$ as observed in the argon-hydrogen plasma. KNO_3 and Raney nickel were used as a source of K catalyst and atomic hydrogen, respectively, to produce the corresponding exothermic reaction. The energy balance was $\Delta H = -17,925\ kcal/mole\ KNO_3$, about 300 times that expected for the most energetic known chemistry of KNO_3, and $-3585\ kcal/mole\ H_2$, over 60 times the hypothetical maximum enthalpy of $-57.8\ kcal/mole\ H_2$ due to combustion of hydrogen with atmospheric oxygen, assuming the maximum possible H_2 inventory. The reduction of KNO_3 to water, potassium metal, and NH_3 calculated from the heats of formation only releases $-14.2\ kcal/mole\ H_2$ which can not account for the observed heat; nor can hydrogen combustion. But, the results are consistent with the formation of $H^-(1/4)$ and $H_2(1/4)$ having enthalpies of formation of over 100 times that of combustion.

110. **R. L. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrides as a New Power Source," Prepr. Pap.-Am. Chem. Soc., Div. Fuel Chem. 2005, 50(2).**

Plasmas of certain catalysts such as K^+, Sr^+, and Ar^+ mixed with hydrogen were studied for evidence of a novel energetic reaction. These hydrogen plasmas called resonant transfer- or rt-plasmas were observed to form at low temperatures (e.g. $\approx 10^3\ K$) and an extraordinary low field strengths of about 1-2 V/cm. Time-dependent line broadening of the H Balmer α line was observed corresponding to extraordinarily fast H (25 eV). Intense hydrogen Lyman emission, a stationary inverted Lyman population, excessive afterglow duration, highly energetic hydrogen atoms, characteristic alkali-ion emission due to catalysis, predicted novel spectral lines, and the measurement of a power beyond any conventional chemistry were also observed. Using a number of spectroscopic and analytical techniques, the reaction products were identified as atoms with energies that are an extension of the Rydberg series to lower states as well as the corresponding molecules and hydride ions. The results show the feasibility of this highly exothermic reaction as a new energy source.

Examiner Souw's refusal to fairly consider this significant evidence displays a level of arrogance that permeates his entire analysis and exposes its glaring weaknesses.

Section 33

In his continued assault on Applicant's scientific evidence, Examiner Souw makes further misstatements on Appendix page 3 that:

> NONE of the experiments done by other independent third party researchers has been able to reproduce Applicant's claimed results [1, 2] (see B.3 .b) below).

This is not true as shown by the 51 independent validations summarized with a listing of the researchers and laboratories in the section entitled "Independent Test Results." Examiner Souw's misstatement merely demonstrates the incompleteness of his analysis based on a disturbing unfamiliarity with the contents of Applicant's submitted evidence.

Section 34

The Examiner continues on pages 3 of the Appendix with the erroneous statement that:

> **(A.3)** <u>**All**</u> of the alleged evidences are only argued based on the fractional energy level of hydrogen, for which there is no theoretical justification (see Part II of this Appendix: Theory).

Nothing could be further from the truth. Essentially all elements were experimentally identified before there was any theory to model their characteristics, including the nonphysical, non-predictive, curve-fitting SQM theory. Applicant's CQM is the first to predict novel lower-energy states of hydrogen. The data confirms the catalysis of hydrogen to these lower-energy states and identifies lower-energy hydrogen. Specially, studies that experimentally confirm a novel reaction of atomic hydrogen which produces hydrogen in fractional quantum states that are at lower energies than the traditional "ground" ($n = 1$) state, a chemically generated or assisted plasma (rt-plasma), and produces novel hydride compounds are summarized in the section entitled, "Lower-Energy Hydrogen Experimental Data" and include including:

extreme ultraviolet (EUV) spectroscopy,[2]

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[2] Reference Nos. 11-16, 20, 24, 27-29, 31-36, 39, 42-43, 46-47, 50-52, 54-55, 57, 59, 63, 65-68, 70-76, 78-79, 81, 83, 85, 86, 89, 91-93, 95-96, 98, 101, 104, 108-112.

characteristic emission from catalysis and the hydride ion products,[3]
lower-energy hydrogen emission,[4]
plasma formation,[5]
Balmer α line broadening,[6]
population inversion of hydrogen lines,[7]
elevated electron temperature,[8]
anomalous plasma afterglow duration,[9]
power generation,[10]
excessive light emission,[11] and
analysis of chemical compounds.[12]

<u>Section 35</u>

In the Section of the Appendix entitled "(B) <u>Specific Arguments</u>," on page 4, Examiner Souw commits further errors in analysis, claiming:

(B.1) Pg.29

> Regarding Applicant's misidentification of the well-known He-II 304 Å line routinely found in solar spectrum as being due to Applicant's non-existent "hydrino" [4] (cited in previous Appendix), the Sun is known to also contain hydrogen and helium. Applicant's attempt to justify Applicant's obvious misidentification of the line by referring to new elements, such as iron, which has no relevance to the disputed 304 Å line, is unpersuasive.

Again, the Examiner has turned a blind eye to the inescapable evidence presented by Applicant. The Novel Lines presented in Ref. [67]: R. L. Mills, P. Ray, "Extreme Ultraviolet Spectroscopy of Helium-Hydrogen Plasma", J. Phys. D, Applied

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[3] Reference Nos. 24, 27, 32, 39, 42, 46, 51-52, 55, 57, 68, 72-73, 81, 89, 91, 108.

[4] Reference Nos. 14, 28-29, 33-36, 50, 63, 67, 70-71, 73, 75-76, 78-79, 86-87, 90, 92, 93, 98, 101, 104, 110-112.

[5] Reference Nos. 11-13, 15-16, 20, 24, 27, 32, 39, 42, 46-47, 51-52, 54-55, 57, 72, 81, 89, 91-93, 108, 109.

[6] Reference Nos. 16, 20, 30, 33-37, 39, 42-43, 49, 51-52, 54-55, 57, 63-65, 68-69, 71-74, 81-85, 88-89, 91, 92, 93, 95-97, 105, 108, 109.

[7] Reference Nos. 39, 46, 51, 54, 55, 57, 59, 65-66, 68, 74, 83, 85, 89, 91.

[8] Reference Nos. 34-37, 43, 49, 63, 67, 73.

[9] Reference Nos. 12-13, 47, 81.

[10] Reference Nos. 30-31, 33, 35-36, 39, 43, 50, 63, 71-73, 76-77, 81, 84, 89, 92, 93, 98, 101, 104, 108, 110-112.

[11] Reference Nos. 11, 16, 20, 23, 31, 37, 43, 52, 72. 109

[12] Reference Nos. 6-10, 19, 25, 38, 41, 44-45, 60-62, 64, 69, 75, 81-82, 87-88, 90, 92, 93, 94, 98, 100, 101, 104, 108, 110-112.

Physics, Vol. 36, (2003), pp. 1535-1542 can be Explained as Electronic Transitions to Fractional Rydberg States of Atomic Hydrogen:

• The novel peaks fit two empirical relationships.

• In order of energy, the set comprising the peaks at $91.2\ nm$, $45.6\ nm$, $30.4\ nm$, $13.03\ nm$, $10.13\ nm$, and $8.29\ nm$ correspond to energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,7,9,\ or\ 11$.

• In order of energy, the set comprising the peaks at $63.3\ nm$, $37.4\ nm$, $20.5\ nm$, and $14.15\ nm$ correspond to energies of $q \cdot 13.6 - 21.21\ eV$ where $q = 3,4,6,\ or\ 8$.

• Electronic transitions to fractional Rydberg states given by

$$E_n = -\frac{e^2}{n^2 8\pi\varepsilon_o a_H} = -\frac{13.598\ eV}{n^2} \qquad n = \frac{1}{2},\frac{1}{3},\frac{1}{4},\dots,\frac{1}{p}; \quad p \text{ is an integer}$$

catalyzed by the resonant nonradiative transfer of $m \cdot 27.2\ eV$ would give rise to a series of emission lines of energies $q \cdot 13.6\ eV$ where q is an integer.

• It is further proposed that the photons that arise from hydrogen transitions may undergo inelastic helium scattering. The general reaction is

$$photon\ (h\nu) + He\ (1s^2) \rightarrow He\ (1s^1 2p^1) + photon\ (h\nu - 21.21\ eV)$$

• Then the two empirical series may be combined. The energies for the novel lines in order of energy are $13.6\ eV$, $27.2\ eV$, $40.8\ eV$, $54.4\ eV$, $81.6\ eV$, $95.2\ eV$, $108.8\ eV$, $122.4\ eV$ and $149.6\ eV$. The corresponding peaks are $91.2\ nm$, $45.6\ nm$, $30.4\ nm$ with $63.3\ nm$, $37.4\ nm$, $20.5\ nm$, $13.03\ nm$, $14.15\ nm$, $10.13\ nm$, and $8.29\ nm$, respectively. Thus, the identified novel lines correspond to energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,4,6,7,8,9,\ or\ 11$ or these lines inelastically scattered by helium atoms wherein $21.2\ eV$ was absorbed in the excitation of $He\ (1s^2)$ to $He\ (1s^1 2p^1)$.

Alternative explanations for these lines were eliminated as given for example in Ref. [67]: R. L. Mills, P. Ray, "Extreme Ultraviolet Spectroscopy of Helium-Hydrogen Plasma", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542 and Ref. [98]: R. L. Mills, Y. Lu, J. He, M. Nansteel, P. Ray, X. Chen, A. Voigt, B. Dhandapani, "Spectral Identification of New States of Hydrogen", Applied Spectroscopy, submitted.

From Ref. [98]:

These strong emissions are not found in any single gas plasma, and cannot be assigned to the known emission of any species of the single gases studied such as H, H^-, H_2, H_2^+, H_3^+, He, He_2^*, and He^+, known species of the mixture such as He_2^+, HeH^+, HeH, HHe_2^+, and HHe_n^+ and He_n, possible contaminants [1], or doubly excited states [2]. However the results can be explained by a novel catalytic reaction involving atomic hydrogen [1, 3-6]

From Ref. [67]:

All known possibilities for the series of novel lines were considered. Spectra of species present in helium hydrogen mixtures and possible impurities were evaluated. The only known species in a helium-hydrogen plasmas are H^+, H_2^+, H_3^+, H^-, H, H_2, He_2^*, HeH^+, and remotely possibly HeH. Other exotic possibilities such as He_2^+, HHe_2^+, HHe_n^+ and He_n were eliminated due to the extremely specialized conditions required for their formation such as extremely low temperatures that were unlike those in the helium-hydrogen microwave plasmas [31-32]. The impurities considered were nitrogen, oxygen, carbon dioxide, and water vapor from air, noble gas contaminants, silicon from the quartz tube, and contaminants from the vacuum system.

Regarding hydrogen species as a candidate of the series of novel lines, hydrogen alone has no known emission in this region ($< 77\ nm$) [5-25] as shown in Figure 1. This is a consequence of the binding energies of H, H_2, and H_2^+ being less than 16.3 eV [43-44], and the binding energy of H^- being only 0.75 eV [26]. The reaction to form H_3^+ is exothermic [45]

$$H_2^+ + H_2 \rightarrow H_3^+ + H + 1.7\ eV \tag{1}$$

From Eq. (1), the binding energy of H_3^+ can not be more than 22.43 eV, the sum of the binding energy of H_2^+, 16.25 eV (given by the sum of the bond energy of H_2^+, 2.651 eV [44], and the binding energy of H, 13.59844 eV [43]), the bond energy of H_2, 4.478 eV [44], and 1.7 eV. The corresponding emission is 55.3 nm which is outside of the region of the novel series observed in the region < 50 nm. Furthermore, H_3^+ possesses

no excited electronic states, and consequently has no observable emission in the ultraviolet or visible regions [27]. H_3^+ can only be observed spectroscopically via vibration-rotational transitions which are in the infrared [27-28].

He_2^* emission is limited to the spectral region > 58.4 nm; thus, it was eliminated [29]. HeH^+ was eliminated since excited states of this ion were predicted to be unstable or only weakly bonding [33]. HeH emission was eliminated as the source of the series of novel peaks due to the extraordinarily low probability that HeH would form under the conditions of the helium-hydrogen microwave discharge. The existence of "bound" excited states of HeH has been shown by emission spectroscopy of HeH molecules produced by two ways: (1) by reactions of He and H_2^*, and (2) in charge exchange collisions between HeH^+ and alkali vapors [34-35]. Conditions for either of these types of reactions were not present in the helium-hydrogen microwave plasmas. In addition, the known emission spectrum of HeH was not observed. In particular, HeH has broad emission peaks in the regions of 160-180 nm [36] and 200-400 nm [35] that were not observed in the helium-hydrogen plasmas, nor has the series of novel peaks been recorded on HeH emission. In addition, the novel series does not match the theoretical spectrum of attractive excited states that decay to a repulsive ground state. The theoretical emission of excited states belong to a Rydberg series that converges to the electronic ground state of the HeH^+ ion [34-35].

Air contaminants were also eliminated. Plasmas of nitrogen, oxygen, carbon dioxide, or these gases with 2% hydrogen showed no emission in the region < 50 nm as shown in Figure 5 for hydrogen mixed with nitrogen, oxygen, and carbon dioxide. In addition, water vapor present in the oxygen-hydrogen plasma showed no emission in this region. Nitrogen was further eliminated since the intensity of the $N\,I\ {}^4S{-}{}^4P$ peaks of the nitrogen microwave plasma at 113.45 nm and 119.96 nm were 500,000 photons/s; whereas, these peaks were absent from the helium-hydrogen emission recorded with the same sensitivity. The spectrum of nitrogen matched that given in the literature [46] and NIST tables [5]. Similarly oxygen, carbon dioxide, and water vapor (oxygen-hydrogen mixture) were eliminated since O I peaks were observed from each plasma with intensities >100,000 photons/s; whereas, these peaks were absent from the helium-hydrogen emission recorded with the same sensitivity. The peaks that were absent from the helium-hydrogen microwave plasma, but were observed as intense peaks from the oxygen, carbon dioxide, and water vapor microwave plasmas were the O II peak at 83.45 nm and O I peaks at 87.79 nm, 93.5 nm, 99.1 nm, 103.92 nm, 104.09 nm, and 115.21 nm.

Emission of argon, krypton, and xenon as helium contaminants were eliminated. No emission was observed in the region <50 nm for xenon, xenon-hydrogen, krypton, and krypton-hydrogen as shown in Figure 6 for krypton or xenon mixed with hydrogen. In the case of the

argon plasma, only known Ar II and III lines were observed at shorter wavelengths as shown in Figure 7. More significantly, the Ar I lines at 93.2 nm, 104.82 nm, and 106.66 nm have an intensities that are about three orders of magnitude that of the Ar II lines at 48.72 nm, 54.76, and 55.68 nm as observed in the argon control and from NIST tables [5]. This and other lines of argon in the region $50-560\ nm$ were not observed.

Neon has peaks at $45.635\ nm$ and $45.527\ nm$. To eliminate the possibility that the $45.6\ nm$ peak shown in Figures 2-4 was due to the presence of neon as an impurity, the EUV spectra ($25-50\ nm$) of the helium-hydrogen mixture (98/2%) (top curve) and control neon (bottom curve) microwave discharge cell emission were recorded with a normal incidence EUV spectrometer and a CEM as shown in Figure 8. The novel lines were not observed in the neon control, and a series of Ne II lines were observed only in the control. The neon peaks at $45.635\ nm$ and $45.527\ nm$ were resolved in Figure 8; whereas, the $45.6\ nm$ peak in the helium-hydrogen plasma was about $3\ nm$ broad. Thus, it was not due to neon impurity. More significantly, the Ne I line at 73.58 nm has an intensity that is about three orders of magnitude that of the Ne II line at $45.635\ nm$ and $45.527\ nm$ as observed in the neon control and from NIST tables [5]. This and other lines of neon in the region $50-560\ nm$ were not observed.

Silicon from the quartz tube wall was eliminated since emission due to Si I, Si II, or Si III is not possible below 56 nm based on the NIST tables [5]. Emission from silicon was also eliminated since no silicon lines were observed in any spectrum in the 5-560 nm region. Using the same quartz tube run under identical conditions, no emission was observed in the region of the novel series ($< 50\ nm$) in the case of the controls microwave discharge plasmas of hydrogen, nitrogen, oxygen, carbon dioxide, helium, krypton, xenon, or 2% hydrogen mixed with each of these gases except for helium.

Pump contaminants were eliminated. In order for pump contaminates to enter the region of the plasma, they must migrate against the pressure gradient of the differential pumping, $< 10^{-5}$ torr compared to 1 torr. This is highly unlikely. Furthermore, a turbo pump was used which does not have pump oil, and no impurities attributed to pumps were observed in any control spectrum in the 5-560 nm region.

The elimination of known explanations indicate a new result. Since the novel peaks were only observed with helium and hydrogen present, new hydrogen, helium, or helium-hydrogen species are possibilities. It is well known that empirically the excited energy states of atomic hydrogen are given by Rydberg equation (Eq. (2a) for $n > 1$ in Eq. (2b)).

$$E_n = -\frac{e^2}{n^2 8\pi\varepsilon_o a_H} = -\frac{13.598\ eV}{n^2} \tag{2a}$$

$$n = 1,2,3,\ldots \tag{2b}$$

The $n = 1$ state is the "ground" state for "pure" photon transitions (i.e. the $n = 1$ state can absorb a photon and go to an excited electronic state, but

it cannot release a photon and go to a lower-energy electronic state). However, an electron transition from the ground state to a lower-energy state may be possible by a resonant nonradiative energy transfer such as multipole coupling or a resonant collision mechanism. Processes such as hydrogen molecular bond formation that occur without photons and that require collisions are common [47]. Also, some commercial phosphors are based on resonant nonradiative energy transfer involving multipole coupling [48].

We propose that atomic hydrogen may undergo a catalytic reaction with certain atoms and ions such as He^+ which singly or multiply ionize at integer multiples of the potential energy of atomic hydrogen, $m \cdot 27.2\ eV$ wherein m is an integer. The theory was given previously [49]. The reaction involves a nonradiative energy transfer to form a hydrogen atom that is lower in energy than unreacted atomic hydrogen that corresponds to a fractional principal quantum number. That is

$$n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \ldots, \frac{1}{p}; \quad p \text{ is an integer; } p \le 137 \tag{2c}$$

replaces the well known parameter $n = \text{integer}$ in the Rydberg equation for hydrogen excited states. Thus, the Rydberg states are extended to lower levels as depicted in Figure 9. The $n = 1$ state of hydrogen and the $n = \frac{1}{\text{integer}}$ states of hydrogen are nonradiative, but a transition between two nonradiative states is possible via a nonradiative energy transfer, say $n = 1$ to $n = 1/2$. Thus, a catalyst provides a net positive enthalpy of reaction of $m \cdot 27.2\ eV$ (i.e. it resonantly accepts the nonradiative energy transfer from hydrogen atoms and releases the energy to the surroundings to affect electronic transitions to fractional quantum energy levels). As a consequence of the nonradiative energy transfer, the hydrogen atom becomes unstable and emits further energy until it achieves a lower-energy nonradiative state having a principal energy level given by Eqs. (2a) and (2c).

The novel peaks fit two empirical relationships. In order of energy, the set comprising the peaks at $91.2\ nm$, $45.6\ nm$, $30.4\ nm$, $13.03\ nm$, $10.13\ nm$, and $8.29\ nm$ correspond to energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,7,9,11$. In order of energy, the set comprising the peaks at $37.4\ nm$, $20.5\ nm$, and $14.15\ nm$ correspond to energies of $q \cdot 13.6 - 21.21\ eV$ where $q = 4,6,8$. These lines can be explained as electronic transitions to fractional Rydberg states of atomic hydrogen given by Eqs. (2a) and (2c) wherein the catalytic system involves helium ions because the second ionization energy of helium is $54.417\ eV$, which is equivalent to $2 \cdot 27.2\ eV$. In this case, $54.417\ eV$ is transferred nonradiatively from atomic hydrogen to He^+ which is resonantly ionized. The electron decays to the $n = 1/3$ state with the further release of $54.417\ eV$ which may be emitted as a photon. The catalysis reaction is

$$54.417\ eV + He^+ + H[a_H] \rightarrow He^{2+} + e^- + H\left[\frac{a_H}{3}\right] + 108.8\ eV \tag{3}$$

$$He^{2+} + e^- \rightarrow He^+ + 54.417\ eV \tag{4}$$

And, the overall reaction is

$$H[a_H] \rightarrow H\left[\frac{a_H}{3}\right] + 54.4\ eV + 54.4\ eV \tag{5}$$

Since the products of the catalysis reaction have binding energies of $m \cdot 27.2\ eV$, they may further serve as catalysts. Thus, further catalytic transitions may occur: $n = \frac{1}{3} \rightarrow \frac{1}{4}$, $\frac{1}{4} \rightarrow \frac{1}{5}$, and so on.

Electronic transitions to Rydberg states given by Eqs. (2a) and (2c) catalyzed by the resonant nonradiative transfer of $m \cdot 27.2\ eV$ would give rise to a series of emission lines of energies $q \cdot 13.6\ eV$ where q is an integer. It is further proposed that the photons that arise from hydrogen transitions may undergo inelastic helium scattering. That is, the catalytic reaction

$$H[a_H] \xrightarrow{He^+} H\left[\frac{a_H}{3}\right] + 54.4\ eV + 54.4\ eV \tag{6}$$

yields $54.4\ eV$ by Eq. (4) and a photon of $54.4\ eV$ ($22.8\ nm$). Once emitted, the photon may be absorbed or scattered. When this photon strikes $He\,(1s^2)$, $21.2\ eV$ may be absorbed in the excitation to $He\,(1s^1 2p^1)$. This leaves a $33.19\ eV$ ($37.4\ nm$) photon peak and a $21.21\ eV$ ($58.4\ nm$) photon from $He\,(1s^1 2p^1)$. Thus, for helium the inelastic scattered peak of $54.4\ eV$ photons from Eq. (3) is given by

$$E = 54.4\ eV - 21.21\ eV = 33.19\ eV\ (37.4\ nm) \tag{7}$$

A novel peak shown in Figures 2-4 was observed at $37.4\ nm$. Furthermore, the intensity of the $58.4\ nm$ peak corresponding to the spectra shown in Figure 4 was about 60,000 photons/sec. Thus, the transition $He\,(1s^2) \rightarrow He\,(1s^1 2p^1)$ dominated the inelastic scattering of EUV peaks. The general reaction is

$$photon\,(h\nu) + He\,(1s^2) \rightarrow He\,(1s^1 2p^1) + photon\,(h\nu - 21.21\ eV) \tag{8}$$

The two empirical series may be combined—one directly from Eqs. (2a, 2c) and the other indirectly with Eq. (8). The energies for the novel lines in order of energy are $13.6\ eV$, $27.2\ eV$, $40.8\ eV$, $54.4\ eV$, $81.6\ eV$, $95.2\ eV$, $108.8\ eV$, $122.4\ eV$ and $149.6\ eV$. The corresponding peaks are $91.2\ nm$, $45.6\ nm$, $30.4\ nm$, $37.4\ nm$, $20.5\ nm$, $13.03\ nm$, $14.15\ nm$, $10.13\ nm$, and $8.29\ nm$, respectively. Thus, the identified novel lines correspond to energies of $q \cdot 13.6\ eV$, $q = 1,2,3,7,9,11$. or $q \cdot 13.6\ eV$, $q = 4,6,8$ less $21.2\ eV$ corresponding to inelastic scattering of these photons by helium atoms due to excitation of $He\,(1s^2)$ to $He\,(1s^1 2p^1)$. The values of q observed are consistent with those expected based on Eq. (5) and the subsequent autocatalyzed reactions as discussed previously [50]. The broad satellite peak at $44.2\ nm$ show in Figure 2-4 is consistent with the reaction mechanism of a nonradiative transfer to a catalyst followed by emission. There is remarkable agreement between the data and the proposed transitions to fractional Rydberg states and these lines inelastically scattered by helium according to Eq. (8). All other peaks

> could be assigned to He I, He II, second order lines, or atomic or molecular hydrogen emission. No known lines of helium or hydrogen explain the $q \cdot 13.6\ eV$ related set of peaks.

The Examiner cites Applicant's paper, 28. R. Mills, P. Ray, "Spectral Emission of Fractional Quantum Energy Levels of Atomic Hydrogen from a Helium-Hydrogen Plasma and the Implications for Dark Matter", Int. J. Hydrogen Energy, (2002), Vol. 27, No. 3, pp. 301-322, as failing to identify the 304 Å line as the He II line. The Examiner shows carelessness and has erred since Applicant has assigned the 304 Å to He II. Table 1 of gives:

304	304	$He^{+}(n=2) \rightarrow He^{+}(n=1) + 40.8\ eV$ [b]	7, 8, 9, 10, 12

In the legend appears:

[b] In Figures 7, 8, 9, 10, and 12, the peak corresponding to $He^{+}(n=3) \rightarrow He^{+}(n=1) + 48.35\ eV$ (256 Å)was absent which makes this assignment difficult.

Furthermore, in Sec. IIIA appears:

> It is also proposed that the 304 Å peak shown in Figures 7, 8, 9, 10 and 12 was not entirely due to the He II transition. Conspicuously absent was the $256\ \AA\ (48.3\ eV)$ line of He II shown in Figures 6 and 8 which implies only a minor He II transition contribution to the 304 Å peak.

The solar spectrum is not the same as the spectrum of a pure helium-hydrogen (98/2%) plasma. The Sun is known to contain the elements even beyond iron (See Table 4.2 of Stix, M., <u>The Sun</u>, Springer-Verlag, Berlin, (1991)). The Examiner fails to get the point that the elements in the controlled spectrum in the laboratory were not the same as the spectrum recorded on the Sun. In the former case, the gas composition was known precisely and controls were run to identify all positive alternative assignments of the emission.

Section 36

Examiner Souw then incorrectly states on page 4 of the Appendix:

In this regard, Applicant's change of argument to *"the observed 304 Å line is not entirely due to ionized helium"* is also unpersuasive because: (1) There is no other element known in the art that may have contributed to the 304 Åline; and (2) It does not remove the fact that Applicant has misidentified the 304 Å line as being due to "hydrino".

Using the proper scientific method, the 304 Å line can not be assigned to He II alone as shown in Section 35 above.

Section 37

Examiner Souw further argues on page 4 of the Appendix:

(B.2) Pg.30

Again, the Examiner is not required to provide alternative explanation; it is sufficient to prove that Applicant's explanation is incredible (see A. 1 above). Since the invention unambiguously claims the effect as being solely due to hydrino, and this hydrino is evidently non-existent, a rejection under 35 U.S.C. § 101 combined with § 112/¶.1 is proper.

This overly simplistic analysis is ripe with errors. As explained below, the Examiner fatally errs in assuming that Applicant's invention is *per se* incredible, without properly considering the scientific experimental evidence of record. The Committee magnifies this error through its twisted logic that there is no amount of evidence Applicant can submit to prove the existence of lower-energy hydrogen due to its supposed "incredibility," as discussed above in the main response. Application of the scientific method demonstrates that hydrino does exist based on direct spectroscopic measurement and measurement of at least 11 conjugate parameters.

Results include confirmation by at least 11 different techniques that are all showing different aspects of the same thing: a powerful reaction of atomic hydrogen and the formation of hydrino. These include (1) a match between the catalysts and the observed emission for the hydrino reaction, (2) signatures of energetic reactions including extraordinarily hot hydrogen atoms, the predicted formation of plasma, and

energetic pumping (excitation) of hydrogen states, (3) large heat of the formation of hydrino, (4) the spectral emission of lower-energy hydrogen atoms, (5) the spectral emission from vibration and rotation of the hydrino molecule, (6) the observation of the corresponding hydrino hydride ion by emission spectroscopy that can not be assigned to any known species, (7) the predicted NMR signature from the hydride ion and the corresponding gas molecule, (8) the binding energy of the molecule and the hydride ion measured by mass spectroscopy and X-ray photoelectron spectroscopy, respectively, (9) the rotational emission of the molecules trapped in the hydride compounds with electron-beam excitation, (10) the isolation and characterization of chemical compounds containing the new hydrides ions that show extraordinary properties and analytical signatures, and most significantly, (11) the exact spectrum predicted for the single-rotational transition of hydrino molecules trapped in the solid compounds. The energies, intensities, line widths, and peak spacing match theory identically, and the results match the body of other evidence from independent techniques. A summary is given in the section entitled "Lower-Energy Hydrogen Experimental Data".

See Applicant's papers such as:

111. R. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrogen Species $H^-(1/4)$ and $H_2(1/4)$ as a New Power Source", Thermochimica Acta, submitted.

ABSTRACT

The data from a broad spectrum of investigational techniques strongly and consistently indicates that hydrogen can exist in lower-energy states then previously thought possible. The predicted reaction involves a resonant, nonradiative energy transfer from otherwise stable atomic hydrogen to a catalyst capable of accepting the energy. The product is $H(1/p)$, fractional Rydberg states of atomic hydrogen wherein $n=\frac{1}{2},\frac{1}{3},\frac{1}{4},\ldots,\frac{1}{p}$; ($p \leq 137$ is an integer) replaces the well known parameter $n = \text{integer}$ in the Rydberg equation for hydrogen excited states. He^+, Ar^+, and K are predicted to serve as catalysts since they meet the catalyst criterion—a chemical or physical process with an enthalpy change equal to an integer multiple of the potential energy of atomic hydrogen, $27.2\ eV$. Specific predictions based on closed-form equations for energy levels were tested. For example, two $H(1/p)$ may react to form $H_2(1/p)$ that have vibrational and rotational energies that are p^2 times those of H_2

comprising uncatalyzed atomic hydrogen. Rotational lines were observed in the 145-300 nm region from atmospheric pressure electron-beam excited argon-hydrogen plasmas. The unprecedented energy spacing of 4^2 times that of hydrogen established the internuclear distance as 1/4 that of H_2 and identified $H_2(1/4)$.

The predicted products of alkali catalyst K are $H^-(1/4)$ which form $KH*X$, a novel alkali halido (X) hydride compound, and $H_2(1/4)$ which may be trapped in the crystal. The ^1H MAS NMR spectrum of novel compound $KH*Cl$ relative to external tetramethylsilane (TMS) showed a large distinct upfield resonance at -4.4 ppm corresponding to an absolute resonance shift of -35.9 ppm that matched the theoretical prediction of $H^-(1/p)$ with $p = 4$. The predicted frequencies of ortho and para-$H_2(1/4)$ were observed at 1943 cm^{-1} and 2012 cm^{-1} in the high resolution FTIR spectrum of $KH*I$ having a -4.6 ppm NMR peak assigned to $H^-(1/4)$. The 1943/2012 cm^{-1}-intensity ratio matched the characteristic ortho-to-para-peak-intensity ratio of 3:1, and the ortho-para splitting of 69 cm^{-1} matched that predicted. $KH*Cl$ having $H^-(1/4)$ by NMR was incident to the 12.5 keV electron-beam which excited similar emission of interstitial $H_2(1/4)$ as observed in the argon-hydrogen plasma. KNO_3 and Raney nickel were used as a source of K catalyst and atomic hydrogen, respectively, to produce the corresponding exothermic reaction. The energy balance was $\Delta H = -17,925\ kcal/mole\ KNO_3$, about 300 times that expected for the most energetic known chemistry of KNO_3, and $-3585\ kcal/mole\ H_2$, over 60 times the hypothetical maximum enthalpy of $-57.8\ kcal/mole\ H_2$ due to combustion of hydrogen with atmospheric oxygen, assuming the maximum possible H_2 inventory. The reduction of KNO_3 to water, potassium metal, and NH_3 calculated from the heats of formation only releases $-14.2\ kcal/mole\ H_2$ which can not account for the observed heat; nor can hydrogen combustion. But, the results are consistent with the formation of $H^-(1/4)$ and $H_2(1/4)$ having enthalpies of formation of over 100 times that of combustion.

The fact that the Examiner can not find an alternative explanation for all these results is due to scientific fact that there is no alternative explanation.

Section 38

On pages 4-5 of the Souw Appendix, the Examiner again raises nonsensical arguments:

(B.3) Pg.33-35

(a) Strong bonding must be evidenced by measurement of material hardness [5], not by mere arguments of anomalies observed in XPS spectral lines. Anomalies may have many other causes, but not by hydrino. The latter must be excluded, for having neither experimental nor theoretical justification.

The Examiner's position is completely bases. XPS can identify all elements and give information about their oxidation state by directly measuring the binding energy of each electron. These energies are characteristic of and identify each element. The measurement of the binding energy of the hydrino hydride ions is a means of direct identification. There are infinite numbers of combinations of materials that can be categorized along an essentially continuous scale of hardness. Applicant is frankly astonished that the Examiner calls to supplant direct characterization with some nebulous hardness measurement. How then would the Examiner identify any given element in the periodic chart? To understand how those educated in materials characterization identify elements, the Examiner should read, for example, C. D. Wagner, W. M. Riggs, L. E. Davis, J. F. Moulder, G. E. Mulilenberg (Editor), *Handbook of X-ray Photoelectron Spectroscopy*, Perkin-Elmer Corp., Eden Prairie, Minnesota, (1997).

Applicant has measured the predicted binding energy of hydrino hydride using XPS, which is confirmed by other independent analytical techniques as given in:

111. **R. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrogen Species $H^-(1/4)$ and $H_2(1/4)$ as a New Power Source", Thermochimica Acta, submitted.**

The data from a broad spectrum of investigational techniques strongly and consistently indicates that hydrogen can exist in lower-energy states then previously thought possible. The predicted reaction involves a resonant, nonradiative energy transfer from otherwise stable atomic hydrogen to a catalyst capable of accepting the energy. The product is $H(1/p)$, fractional Rydberg states of atomic hydrogen wherein $n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \ldots, \frac{1}{p}$; ($p \leq 137$ is an integer) replaces the well known parameter $n = \text{integer}$ in the Rydberg equation for hydrogen excited states. He^+, Ar^+, and K are predicted to serve as catalysts since they meet the catalyst criterion—a chemical or physical process with an enthalpy change equal to an integer multiple of the potential energy of atomic hydrogen,

$27.2\ eV$. Specific predictions based on closed-form equations for energy levels were tested. For example, two $H(1/p)$ may react to form $H_2(1/p)$ that have vibrational and rotational energies that are p^2 times those of H_2 comprising uncatalyzed atomic hydrogen. Rotational lines were observed in the 145-300 nm region from atmospheric pressure electron-beam excited argon-hydrogen plasmas. The unprecedented energy spacing of 4^2 times that of hydrogen established the internuclear distance as 1/4 that of H_2 and identified $H_2(1/4)$.

The predicted products of alkali catalyst K are $H^-(1/4)$ which form $KH*X$, a novel alkali halido (X) hydride compound, and $H_2(1/4)$ which may be trapped in the crystal. The ^1H MAS NMR spectrum of novel compound $KH*Cl$ relative to external tetramethylsilane (TMS) showed a large distinct upfield resonance at -4.4 ppm corresponding to an absolute resonance shift of -35.9 ppm that matched the theoretical prediction of $H^-(1/p)$ with p = 4. The predicted frequencies of ortho and para-$H_2(1/4)$ were observed at 1943 cm^{-1} and 2012 cm^{-1} in the high resolution FTIR spectrum of $KH*I$ having a -4.6 ppm NMR peak assigned to $H^-(1/4)$. The 1943/2012 cm^{-1}-intensity ratio matched the characteristic ortho-to-para-peak-intensity ratio of 3:1, and the ortho-para splitting of 69 cm^{-1} matched that predicted. $KH*Cl$ having $H^-(1/4)$ by NMR was incident to the 12.5 keV electron-beam which excited similar emission of interstitial $H_2(1/4)$ as observed in the argon-hydrogen plasma. KNO_3 and Raney nickel were used as a source of K catalyst and atomic hydrogen, respectively, to produce the corresponding exothermic reaction. The energy balance was $\Delta H = -17,925\ kcal/mole\ KNO_3$, about 300 times that expected for the most energetic known chemistry of KNO_3, and $-3585\ kcal/mole\ H_2$, over 60 times the hypothetical maximum enthalpy of $-57.8\ kcal/mole\ H_2$ due to combustion of hydrogen with atmospheric oxygen, assuming the maximum possible H_2 inventory. The reduction of KNO_3 to water, potassium metal, and NH_3 calculated from the heats of formation only releases $-14.2\ kcal/mole\ H_2$ which can not account for the observed heat; nor can hydrogen combustion. But, the results are consistent with the formation of $H^-(1/4)$ and $H_2(1/4)$ having enthalpies of formation of over 100 times that of combustion.

110. **R. L. Mills, J. He, Z. Chang, W. Good, Y. Lu, B. Dhandapani, "Catalysis of Atomic Hydrogen to Novel Hydrides as a New Power Source," Prepr. Pap.-Am. Chem. Soc., Div. Fuel Chem. 2005, 50(2).**

Plasmas of certain catalysts such as K^+, Sr^+, and Ar^+ mixed with hydrogen were studied for evidence of a novel energetic reaction. These hydrogen plasmas called resonant transfer- or rt-plasmas were observed

to form at low temperatures (e.g. $\approx 10^3\ K$) and an extraordinary low field strengths of about 1-2 V/cm. Time-dependent line broadening of the H Balmer α line was observed corresponding to extraordinarily fast H (25 eV). Intense hydrogen Lyman emission, a stationary inverted Lyman population, excessive afterglow duration, highly energetic hydrogen atoms, characteristic alkali-ion emission due to catalysis, predicted novel spectral lines, and the measurement of a power beyond any conventional chemistry were also observed. Using a number of spectroscopic and analytical techniques, the reaction products were identified as atoms with energies that are an extension of the Rydberg series to lower states as well as the corresponding molecules and hydride ions. The results show the feasibility of this highly exothermic reaction as a new energy source.

25. **R. Mills, W. Good, A. Voigt, Jinquan Dong, "Minimum Heat of Formation of Potassium Iodo Hydride", Int. J. Hydrogen Energy, Vol. 26, No. 11, Oct., (2001), pp. 1199-1208.**

It was previously reported [R. Mills, B. Dhandapani, N. Greenig, J. He, "Synthesis and Characterization of Potassium Iodo Hydride", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1185-1203.] that a novel inorganic hydride compound KHI which comprised a high binding energy hydride ion was synthesized by reaction of atomic hydrogen with potassium metal and potassium iodide. Potassium iodo hydride was identified by time of flight secondary ion mass spectroscopy, X-ray photoelectron spectroscopy, ^1H and ^{39}K nuclear magnetic resonance spectroscopy, Fourier transform infrared spectroscopy, electrospray ionization time of flight mass spectroscopy, liquid chromatography/mass spectroscopy, thermal decomposition with analysis by gas chromatography, and mass spectroscopy, and elemental analysis. We report measurements of heats of formation of KHI by differential scanning calorimetry (DSC). With reactant KI present, potassium metal catalyst and atomic hydrogen were produced by decomposition of KH at an extremely slow rate under a helium atmosphere to increase the amount of atomic hydrogen by slowing the rate of molecular hydrogen formation. Since not all of the starting materials reacted, the observed minimum heats of formation were over $-2000\ kJ/mole\ H_2$ compared to the enthalpy of combustion of hydrogen of $-241.8\ kJ/mole\ H_2$.

Section 39

Examiner Souw erroneously asserts on page 5 of his Appendix that:

(b) Applicant's XPS line anomaly has been identified by an independent third party as an impurity line: it disappeared after surface cleaning [3]. This refutation has been recited in the previous Appendix, but failed to be

addressed in Applicant's response. Therefore, Applicant's insistence of this line of being a "hydrino" line remains unpersuasive on both experimental and theoretical grounds.

The "cleaning" was ion sputtering to remove contamination due to handling the sample, if any. No contamination was noted by comparing the before and after results. From paper #68:

ToF-SIMS Characterization

The commercial silicon wafer, HF cleaned silicon wafer, and $\alpha - SiH$ coated nickel foil samples were characterized using Physical Electronics TRIFT ToF-SIMS instrument. The primary ion source was a pulsed $^{69}Ga^{+}$ liquid metal source operated at 15 keV [32-33]. The secondary ions were exacted by a ± 3 keV (according to the mode) voltage. Three electrostatic analyzers (Triple-Focusing-Time-of-Flight) deflect them in order to compensate for the initial energy dispersion of ions of the same mass. The 400 pA dc current was pulsed at a 5 kHz repetition rate with a 7 ns pulse width. The analyzed area was 60μm x 60μm and the mass range was 0-1000 AMU. The total ion dose was $7\ X10^{11}\ ions/cm^{2}$, ensuring static conditions. Charge compensation was performed with a pulsed electron gun operated at 20 eV electron energy. In order to remove surface contaminants and expose a fresh surface for analysis, the samples were sputter-cleaned for 30 s using a 80μm x 80μm raster, with 600 pA current, resulting in a total ion dose of $10^{15}\ ions/cm^{2}$. Three different regions on each sample of 60μm x 60μm were analyzed. The positive and negative SIMS spectra were acquired. Representative post sputtering data is reported. The ToF-SIMS data were treated using 'cadence' software (Physical Electronics), which calculates the mass calibration from well-defined reference peaks.

The hydride was not removed with sputtering which showed that the sample was in fact hydride. It also confirmed the source of the novel XPS peaks was a hydride film.

XPS and TOF-SIMS can identify all of the known elements in all of the oxidation states known for the particular element. There is no element or oxidation state of an element called "impurity". Since the peaks could not be assigned to any known element in any oxidation state as shown by the survey scan, Figure 12 of paper 61, compared to the XPS data of the known elements and their oxidation states (See Ref. 35 of paper 61-C. D. Wagner, W. M. Riggs, L. E. Davis, J. F. Moulder, G. E. Mulilenberg (Editor), *Handbook of X-ray Photoelectron Spectroscopy*, Perkin-Elmer Corp., Eden Prairie, Minnesota, (1997), it must be to an element with a new binding energy. The coating is

hydride as shown by TOF-SIMS that is orders of magnitude more stable than ordinary hydride as shown by TOF-SIMS and XPS, and the XPS peaks matched those predicted for hydrino hydride. Thus, the assignment to lower-energy hydrogen is well supported by the data; whereas, an alternative assignment is not.

From paper # 61:

The 0-70 eV binding energy region of a nickel foil coated with an $\alpha - SiH$ film and exposed to air for 20 min. before XPS analysis is shown in Figure 21. By comparison of the $\alpha - SiH$ sample to the controls, novel XPS peaks were identified at 11, 43, and 55 eV. These peaks do not correspond to any of the primary elements, silicon, carbon, or oxygen, shown in the survey scan in Figure 12, wherein the peaks of these elements are given by Wagner et al. [35]. Hydrogen is the only element which does not have primary element peaks; thus, it is the only candidate to produce the novel peaks and correspond to the H content of the SiH coatings. These peaks closely matched hydrides formed by the catalytic reaction of He^+ with atomic hydrogen and subsequent reactions to form highly stable silicon hydride products $\alpha - SiH$ that were discussed previously [31].

From paper 45:

The energetic plasma reaction was used to synthesize a potentially commercially important product. Nickel substrates were coated by the reaction product of a low pressure microwave discharge plasma of SiH_4 (2.5%)/He (96.6%)/H_2 (0.9%). The ToF-SIMS identified the coatings as hydride by the large SiH^+ peak in the positive spectrum and the dominant H^- in the negative spectrum. XPS identified the H content of the SiH coatings as hydride ions, $H^-(1/4)$, $H^-(1/9)$, and $H^-(1/11)$ corresponding to peaks at 11, 43, and 55 eV, respectively. The novel hydride ions are proposed to form by the catalytic reaction of He^+ with atomic hydrogen and subsequent autocatalytic reactions of $H(1/p)$ to form highly stable silicon hydride products $SiH(1/p)$ (p is an integer greater than one in Eqs. (4-5)). The SiH coating was amorphous as indicated by the shape of the $Si\ 2p$ peak and was remarkably stable to air exposure. After a 48 hour exposure to air, essentially no oxygen was observed as evidence by the negligible $O\ 1s$ peak at 531 eV and absence of any SiO_x Si $2p$ peak in the region of 102-104 eV. The highly stable amorphous silicon hydride coating may advance the production of integrated circuits and microdevices by resisting the oxygen passivation of the surface and

possibly altering the dielectric constant and band gap to increase device performance.

Section 40

Examiner Souw further mischaracterizes Applicant's scientific evidence on page 5 of the Appendix:

(c) Pg.36-37

The experiment of Marchese et al. cited by Applicant has proven by hard evidence that the reaction suggested by Applicant is not more efficient than conventional reaction (A. Marchese's **Final Report [1] pg.33, lines 1-2 below Fig.29**).

The Examiner has taken the data on a nozzle design out of context. Marchese et al. independently replicated Applicant's results and were not paid (a standard set by the Examiner (see Section 12 of Applicant's main response):

44. A. J. Marchese, P. M. Jansson, J. L. Schmalzel, "The BlackLight Rocket Engine", Phase I Final Report, NASA Institute for Advanced Concepts Phase I, May 1-November 30, 2002, http://www.niac.usra.edu/files/studies/final_report/pdf/752Marchese.pdf.

Rowan University Professors A. J. Marchese, P. M. Jansson, J. L. Schmalzel performed verification studies as visiting researchers at BlackLight Power, Cranbury, NJ. The prior reported results of BlackLight Power, Inc. of extraordinarily broadened atomic hydrogen lines, population inversion, lower-energy hydrogen lines, and excess power measured by water bath calorimetry were replicated. The application of the energetic hydrogen to propulsion was studied.

Specifically, the data supporting hydrinos was replicated. See

i.) BlackLight Process Theory (pp. 10-12) which gives the theoretical energy levels for hydrinos and the catalytic reaction to form hydrinos,

ii.) Unique Hydrogen Line Broadening in Low Pressure Microwave Water Plasmas (pp. 25-27, particularly Fig. 21) which shows that in the same microwave cavity driven at the same power, the temperature of the hydrogen atoms in the microwave plasma where the hydrino reaction was active was 50 times that of the control based on the spectroscopic line widths,

iii.) Inversion of the Line Intensities in Hydrogen Balmer Series (pp. 27-28, particularly Fig. 22) which shows for the first time in 40 years of intensive worldwide research that atomic hydrogen population inversion

was achieved in a steady state plasma and supports the high power released from the reaction of hydrogen to form hydrinos,

iv.) Novel Vacuum Ultraviolet (VUV) Vibration Spectra of Hydrogen Mixture Plasmas (pp. 28-29, particularly Fig. 23) which shows a novel vibrational series of lines in a helium-hydrogen plasmas at energies higher than any known vibrational series and it identically matches the theoretical prediction of 2 squared times the corresponding vibration of the ordinary hydrogen species, and

v.) Water Bath Calorimetry Experiments Showing Increased Heat Generation (pp. 29-30, particularly Fig. 25) that shows that with exactly the same system and same input power, the heating of the water reservoir absolutely measured to 1% accuracy was equivalent to 55 to 62 W with the catalyst-hydrogen mixture compared to 40 W in the control without the possibility of the reaction to form hydrinos.

The energetic hydrogen measured in rt-plasmas taught by Applicant was applied to a nozzle design. The context of the statement is evident: "As shown in Fig. 29b, the measured C* values are on the same order as those of chemical rocket propulsion, which is reasonable for the proof of concept test."

Section 41

Examiner Souw further argues on page 5 of the Appendix:

> In addition, EarthTech, which is an independent research company, failed to confirm Applicant's claimed result. EarthTech's effort to replicate Applicant's claim is documented at <http://www.earthtech.org/experiments/blp/prelim.html> [2a], and the negative finding at <http://www.earthtech.org/experiments/mills/mills1.html> [2b]. Based on these two negative results alone among others [2a, 2b], Applicant's arguments on pg.36-37 must be deemed unpersuasive. Consequently, Applicant's claim of having invented a novel, more efficient chemical process, is deemed incredible.
>
> For reasons stated above, publications from A.J. Marchese relating to "hydrino" are not counted as support, but instead, as a refutation of Applicant's claim, in support of the Examiner's. These include "evidence" nos.16 and 44.

The EarthTech issue and the fact that many top laboratories that were not direct competitors of Applicant replicated the very same experiments are discussed in Section 29 above. The two results cited by the Examiner were not negative, as discussed in

Sections 21-22 of Applicant's main response. Marchese replicated many aspect's of Applicant's Invention as stated in his report and discussed in Sections 29 and 40 above. Examiner Souw's refusal to acknowledge these facts is further evidence of his blatent bias against Applicant.

Section 42

Examiner Souw incorrectly argues on pages 6-7 of his Appendix that:

(d) Regarding pg. 137-138 of Applicant's main 161 page Response dated 08/11/2004, that the 0.16 nm line broadening cited by the Examiner Souw is allegedly *"negligible to the >**10 eV hot H** found in Applicant's rt-plasmas"*, and further, on pg. 142 of 161, *"absolutely negligible compared to the >**100 eV hot H** found in rt-plasmas"*, must be dismissed for the following reasons:

(d. 1) The 0.16 nm broadening (equivalent to 3,7 cm^{-1}) is cited by Examiner Souw to be compared with the 0.27 nm broadening measured by Applicant, but not to *"10 eV or 100 eV hot HI"* as alleged by Applicant. This purpose is unambiguously clear in this reproduced passage from the Examiner's Appendix attached to the previous action:

*"Secondly, and most importantly, anomalous hydrogen line broadening is not at all an evidence for the existence of hydrino, because it is well known in the art that such a broadening may be caused by many other conventional mechanisms, such as microwave plasm3a effects, the latter having not been considered by Applicant. Instead, such an effect has been so far ignored or dismissed by Applicant without any valid reason. The measured excessive line-width shown in Applicant 's Fig. 6 of ref. [6], i.e., **0.27nm**. is about the same magnitude as what is measured by other authors, e.g., ref. [5] cited in the May 7 Appendix, here reproduced in Fig. 1 below.*

As shown in Fig. [1], the anomalous line width of **0.16 nmn**, measured in a microwave discharge similar to Applicant 's under the same gas mixture and pressure range, is about 10 *times the Doppler width, and has been attributed to microwave plasma effects." (ref [5] Luggenhoelscher et al.; Ref [6] Mills et a!.)*

Obviously, Applicant has misrepresented the original dispute over Applicant's 0.27 linewidth by changing or shifting the original subject matter into something else (translational kinetic energy; see below).

Examiner Souw is not only confused, but is not internally consistent even with the views expressed in the same Office Action. As reported in Section 18 of Applicant's main response, the Committee states that

> Applicant has also seriously misinterpreted the Examiner's plasma arguments by incorrectly comparing the Examiner's cited line broadening of 0.16 nm in the prior art with >100 eV hot H found in applicant's rt-plasmas. Due to applicant's misinterpretation of the Examiner's statements, the data of the prior art and his own data, he incorrectly states that the line broadening observed in Luggenhoelscher is off by six orders of magnitude as compared to applicant's observed line widths on page 169 of the present response. The applicant's misinterpretation of the Examiner's remarks on his plasma data, those of the cited prior art, and his own data are detailed on pages 6-12 of the attached appendix (Part I, section B (subsections d.1-d.6, e, and f)).

This is in direct contradiction to the position espoused in a previous Office Action, wherein the opposite is stated:

> Applicant points out that the reasons for Balmer line broadening are discussed in many articles, and that the observed broadening is in excess in what can be expected from known sources thereof. This is not persuasive because broadening may be caused by various means including those taken into account by applicant, and those not taken into account. In the enclosed article by Luggenholscher, et. al. , broadening equivalent to that found by applicant, shown in figure 1, is accounted for by conventionally known explanations such as the Stark effect. The enclosed article by Luque et. al. accounts for Halpha broadening using two Lorentzian mechanisms (Stark and Van der Waals) and two Gaussian mechanisms (Doppler and instrumental).

Then in this section, the Examiner returns to the Committee's original position even in light of the strongly emphasized paper of Jovicevic et al. In S. Jovicevic, M. Ivkovic, N. Konjevic, S. Popovic, L. Vuskovic, J. Appl. Phys. 95, 24 (2004), the authors state that it was impossible to measure any microwave field effect or Stark effect and it would require a resolution of better than about 0.02 nm (See P. 28 line 14).

The broadening reported in the Examiner's reference URL: http://www.phys.tue.nl/FLTPD/Luggenhoelscher.pdf is 0.37 cm-1 with no field and 3.7 cm-1 with the application of the microwave field. The energies corresponding to these widths are $4.5\ X10^{-5}\ eV$ and $4.5\ X10^{-4}\ eV$, respectively, which is absolutely negligible compared to the >10 eV hot H found in rt-plasmas. The microwave field can not

explain Applicant's results. The Examiner's alternative explanation is off by six orders of magnitude.

The Examiner is grossly in error of the relative difference between the results in Applicant's paper #49 and those of the Examiner's Luque et al. paper. The broadening reported in the Examiner's reference URL: http://www.phys.tue.nl/FLTPD/Luggenhoelscher.pdf is 0.37 cm-1 with no field and 3.7 cm-1 with the application of the microwave field. The energies corresponding to these widths are $4.5\ X10^{-5}\ eV$ and $4.5\ X10^{-4}\ eV$, respectively, which is absolutely negligible compared to the >10 eV hot H found in rt-plasmas. The microwave field can not explain Applicant's results. The microwave field can not explain Applicant's results of extraordinary broadening observed in these cells with catalysts present and not observed under identical conditions with no catalyst present.

The Examiner should take better care to read the units of Fig. [1] that are in cm-1, **NOT nm**. The difference is about **SIX ORDERS MAGNITUDE in H energy**.

The Examiner exhibits the same pattern of internal inconsistency with his argument of the basis of SQM. SQM is not a theory based on physical laws as stated by the Examiner. It has nothing to do with physics. It is purely mathematical and relies on metaphysical beliefs that reality is created by measurement, that virtual particles exist in every point in space, that extra compactified dimensions exist that can not be observed, that spooky actions at distance are the norm, that infinities exist, but can be renormalized, etc. This is the truth of the Examiner's position that he falsely and unfairly projects onto Applicant when Applicant has rigorously derived his results from Maxwell's' equations, Newton's laws and special relativity. As is common practice by quantum aficionados, the Examiner grossly distorts and hypes the capabilities of SQM. Applicant's results are closed-form equations with fundamental constants only. The results are predictive in that the solution for any given parameter is predictive of the conjugate parameters. There is not an single example in SQM where this is the case. Furthermore, if SQM were required to adhere to physical laws and internal consistency, there is not even a single example of a successful prediction.

Section 43

On page 7 of the Souw Appendix, the Examiner presents yet another nonsensical argument:

> (d.2) By reciting 10 eV on pg. 138, but 100 eV on pg.142, not only has Applicant compared to a differently related quantity (presumed translational kinetic energy; see next), but also has Applicant failed to particularly point out the subject matter he wants to raise (10 eV or 100 eV?).

The Examiner is obviously confused. Doppler broadening is due to kinetic energy as given in Applicant's papers, the papers cited by the Examiner:

> S. Jovicevic, M. Ivkovic, N. Konjevic, S. Popovic, L. Vuskovic, J. Appl. Phys. 95, 24 (2004).
> N. Cvetanovic, M. M. Kuraica and N. Konjevic, J. Appl. Phys. 97, 33302 (2005).

and many others:

1. M. Kuraica, N. Konjevic, "Line shapes of atomic hydrogen in a plane-cathode abnormal glow discharge", Physical Review A, Volume 46, No. 7, October (1992), pp. 4429-4432.
2. M. Kuraica, N. Konjevic, M. Platisa and D. Pantelic, *Spectrochimica Acta* Vol. 47, 1173 (1992).
3. I. R. Videnovic, N. Konjevic, M. M. Kuraica, "Spectroscopic investigations of a cathode fall region of the Grimm-type glow discharge", Spectrochimica Acta, Part B, Vol. 51, (1996), pp. 1707-1731.
4. S. Alexiou, E. Leboucher-Dalimier, "Hydrogen Balmer-α in dense plasmas", Phys, Rev. E, Vol. 60, No. 3, (1999), pp. 3436-3438.
5. S. Djurovic, J. R. Roberts, "Hydrogen Balmer alpha line shapes for hydrogen-argon mixtures in a low-pressure rf discharge", J. Appl. Phys., Vol. 74, No. 11, (1993), pp. 6558-6565.
6. S. B. Radovanov, K. Dzierzega, J. R. Roberts, J. K. Olthoff, Time-resolved Balmer-alpha emission from fast hydrogen atoms in low pressure, radio-frequency discharges in hydrogen", Appl. Phys. Lett., Vol. 66, No. 20, (1995), pp. 2637-2639.
7. S. B. Radovanov, J. K. Olthoff, R. J. Van Brunt, S. Djurovic, "Ion kinetic-energy distributions and Balmer-alpha (H_α) excitation in $Ar-H_2$ radio-frequency discharges", J. Appl. Phys., Vol. 78, No. 2, (1995), pp. 746-757.
8. R. L. Mills, P. Ray, "Substantial Changes in the Characteristics of a Microwave Plasma Due to Combining Argon and Hydrogen", New Journal of Physics, www.njp.org, Vol. 4, (2002), pp. 22.1-22.17.
9. R. L. Mills, P. Ray, B. Dhandapani, R. M. Mayo, J. He, "Comparison of

Excessive Balmer α Line Broadening of Glow Discharge and Microwave Hydrogen Plasmas with Certain Catalysts", J. of Applied Physics, Vol. 92, No. 12, (2002), pp. 7008-7022.
10. R. Mills and M. Nansteel, P. Ray, "Argon-Hydrogen-Strontium Discharge Light Source", IEEE Transactions on Plasma Science, Vol. 30, No. 2, (2002), pp. 639-653.
11. R. Mills, M. Nansteel, and P. Ray, "Excessively Bright Hydrogen-Strontium Plasma Light Source Due to Energy Resonance of Strontium with Hydrogen", J. of Plasma Physics, Vol. 69, (2003), pp. 131-158.
12. R. Mills and M. Nansteel, P. Ray, "Bright Hydrogen-Light Source due to a Resonant Energy Transfer with Strontium and Argon Ions", New Journal of Physics, Vol. 4, (2002), pp. 70.1-70.28.
13. R. L. Mills, P. Ray, B. Dhandapani, J. He, "Comparison of Excessive Balmer α Line Broadening of Inductively and Capacitively Coupled RF, Microwave, and Glow Discharge Hydrogen Plasmas with Certain Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. (2003), pp. 338-355.
14. R. L. Mills, P. Ray, "Extreme Ultraviolet Spectroscopy of Helium-Hydrogen Plasma", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542.
15. R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "New Power Source from Fractional Quantum Energy Levels of Atomic Hydrogen that Surpasses Internal Combustion", J Mol. Struct., Vol. 643, No. 1-3, (2002), pp. 43-54.
16. R. Mills, P. Ray, R. M. Mayo, "CW H I Laser Based on a Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Group I Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. 2, (2003), pp. 236-247.
17. R. L. Mills, P. Ray, "Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Catalysts", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1504-1509.

Section 44

Examiner Souw continues his misguided arguments on page 7 of the Appendix, stating that:

> (d.3) Applicant is silent about writing the 3.7 cm^{-1} linewidth in wavelength unit. The alternative expression, δλ= 0.16 nm, obviates Applicant's δλ=0.27 nm, <u>without ever postulating or presuming any Doppler effect</u>. Instead, Applicant chose to express the observed line width in [eV] unit, which is simply obtained by multiplying the linewidth originally in units of wavenumber (3.7 cm^{-1}) with c=3·0^{10} cm/sec, thus resulting in δλ 100 GHz, and further multiplying with the Planck constant h=4x10^{-15} eV?sec to give approximately h?äí?0.45 meV. While the expression hí bears the physical

meaning of a kinetic energy of an oscillating electron having a frequency í, the new quantity h?äí would mean a blur or spread in the oscillation kinetic energy of a radiating electron transition dipole, the latter being a QM entity without classical correspondence (=<$ø_2$??|**a·D** |$ø_1$>; see original Appendix, sect.3/pg.7). This blur may be due to Stark effect or microwave effect or something else that does not need to be further specified at this point. However, Applicant proceeds to improperly compare this line width with a hypothetical 10-100 eV translational kinetic energy, which is not just in a different unit, but of a totally different nature involving a sequence of presumptions that is not only controversial, but also disputable, as will be described next. Thus, Applicant is comparing “apples” to “oranges”.

Again, the Examiner is deeply confused. The standard unit for reporting line broadening in the plasmas of interest in this case are electron volts (eV). See the following papers including those cited by the Examiner:

S. Jovicevic, M. Ivkovic, N. Konjevic, S. Popovic, L. Vuskovic, J. Appl. Phys. 95, 24 (2004).
N. Cvetanovic, M. M. Kuraica and N. Konjevic, J. Appl. Phys. 97, 33302 (2005).

and many others:

1. M. Kuraica, N. Konjevic, "Line shapes of atomic hydrogen in a plane-cathode abnormal glow discharge", Physical Review A, Volume 46, No. 7, October (1992), pp. 4429-4432.
2. M. Kuraica, N. Konjevic, M. Platisa and D. Pantelic, *Spectrochimica Acta* Vol. 47, 1173 (1992).
3. I. R. Videnovic, N. Konjevic, M. M. Kuraica, "Spectroscopic investigations of a cathode fall region of the Grimm-type glow discharge", Spectrochimica Acta, Part B, Vol. 51, (1996), pp. 1707-1731.
4. S. Alexiou, E. Leboucher-Dalimier, "Hydrogen Balmer-α in dense plasmas", Phys, Rev. E, Vol. 60, No. 3, (1999), pp. 3436-3438.
5. S. Djurovic, J. R. Roberts, "Hydrogen Balmer alpha line shapes for hydrogen-argon mixtures in a low-pressure rf discharge", J. Appl. Phys., Vol. 74, No. 11, (1993), pp. 6558-6565.
6. S. B. Radovanov, K. Dzierzega, J. R. Roberts, J. K. Olthoff, Time-resolved Balmer-alpha emission from fast hydrogen atoms in low pressure, radio-frequency discharges in hydrogen", Appl. Phys. Lett., Vol. 66, No. 20, (1995), pp. 2637-2639.
7. S. B. Radovanov, J. K. Olthoff, R. J. Van Brunt, S. Djurovic, "Ion kinetic-energy distributions and Balmer-alpha (H_α) excitation in $Ar - H_2$ radio-frequency discharges", J. Appl. Phys., Vol. 78, No. 2, (1995), pp. 746-

757.
8. R. L. Mills, P. Ray, "Substantial Changes in the Characteristics of a Microwave Plasma Due to Combining Argon and Hydrogen", New Journal of Physics, www.njp.org, Vol. 4, (2002), pp. 22.1-22.17.
9. R. L. Mills, P. Ray, B. Dhandapani, R. M. Mayo, J. He, "Comparison of Excessive Balmer α Line Broadening of Glow Discharge and Microwave Hydrogen Plasmas with Certain Catalysts", J. of Applied Physics, Vol. 92, No. 12, (2002), pp. 7008-7022.
10. R. Mills and M. Nansteel, P. Ray, "Argon-Hydrogen-Strontium Discharge Light Source", IEEE Transactions on Plasma Science, Vol. 30, No. 2, (2002), pp. 639-653.
11. R. Mills, M. Nansteel, and P. Ray, "Excessively Bright Hydrogen-Strontium Plasma Light Source Due to Energy Resonance of Strontium with Hydrogen", J. of Plasma Physics, Vol. 69, (2003), pp. 131-158.
12. R. Mills and M. Nansteel, P. Ray, "Bright Hydrogen-Light Source due to a Resonant Energy Transfer with Strontium and Argon Ions", New Journal of Physics, Vol. 4, (2002), pp. 70.1-70.28.
13. R. L. Mills, P. Ray, B. Dhandapani, J. He, "Comparison of Excessive Balmer α Line Broadening of Inductively and Capacitively Coupled RF, Microwave, and Glow Discharge Hydrogen Plasmas with Certain Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. (2003), pp. 338-355.
14. R. L. Mills, P. Ray, "Extreme Ultraviolet Spectroscopy of Helium-Hydrogen Plasma", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542.
15. R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "New Power Source from Fractional Quantum Energy Levels of Atomic Hydrogen that Surpasses Internal Combustion", J Mol. Struct., Vol. 643, No. 1-3, (2002), pp. 43-54.
16. R. Mills, P. Ray, R. M. Mayo, "CW H I Laser Based on a Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Group I Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. 2, (2003), pp. 236-247.
17. R. L. Mills, P. Ray, "Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Catalysts", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1504-1509.

The Examiner is also grossly in error of the relative difference between the results in Applicant's paper #49 and those of the Examiner's Luque et al. paper. The broadening reported in the Examiner's reference URL: http://www.phys.tue.nl/FLTPD/Luggenhoelscher.pdf is 0.37 cm-1 with no field and 3.7 cm-1 with the application of the microwave field. The energies corresponding to these widths are $4.5\ X10^{-5}\ eV$ and $4.5\ X10^{-4}\ eV$, respectively, which is absolutely negligible

compared to the >10 eV hot H found in rt-plasmas. The microwave field can not explain Applicant's results. The microwave field can not explain Applicant's results of extraordinary broadening observed in these cells with catalysts present and not observed under identical conditions with no catalyst present.

The Examiner should take better care to read the units of Fig. [1] that are in cm-1, **NOT nm**. The difference is about **SIX ORDERS MAGNITUDE in H energy**.

Specially, the width reported in energy is 3.7 cm-1 corresponding to 4.5 meV. The method to calculate the energetic hydrogen atom energies from the width of the 656.3 nm Balmer α line is given by Videnovic et al. [3. I. R. Videnovic, N. Konjevic, M. M. Kuraica, "Spectroscopic investigations of a cathode fall region of the Grimm-type glow discharge", Spectrochimica Acta, Part B, Vol. 51, (1996), pp. 1707-1731]. The full half-width $\Delta\lambda_G$ of each Gaussian results from the Doppler ($\Delta\lambda_D$) and instrumental ($\Delta\lambda_I$) half-widths:

$$\Delta\lambda_G = \sqrt{\Delta\lambda_D^2 + \Delta\lambda_I^2} \tag{1}$$

$\Delta\lambda_I$ for these experiments was 0.05 nm. The temperature was calculated from the Doppler half-width using the formula:

$$\Delta\lambda_D = 7.16\,X\,10^{-7}\lambda_0\left(\frac{T}{\mu}\right)^{1/2} \tag{2}$$

where λ_0 is the line wavelength, T is the temperature in K ($1\ eV = 11{,}605\ K$), and μ is the molecular weight (=1 for hydrogen).

Thus, the line width in nm corresponding to an energy of 3.7 cm-1 (4.5 meV) is given by

$$\Delta\lambda_D = 7.16\,X\,10^{-7}(656nm)\left(\frac{4.5X10^{-3}(11{,}605K/eV)}{1}\right)^{1/2} \tag{3}$$

$$0.001\ nm$$

which is absolutely trivial.

The carelessness of the Examiner and the fact that he is waffling is shown in Section 42 above. This is obvious given that the Examiner went from arguing no broadening then to his original position of broadening with a trivial explanation of microwave field broadening even in light of the strongly emphasized paper of Jovicevic

et al. In S. Jovicevic, M. Ivkovic, N. Konjevic, S. Popovic, L. Vuskovic, J. Appl. Phys. 95, 24 (2004), the authors state that it was impossible to measure any microwave field effect or Stark effect and it would require a resolution of better than about 0.02 nm (See P. 28 line 14). Even more disturbing is that the Examiner has based a major portion of his rejection of a subject matter over which he is obviously confused to the point that he fails to distinguish between units of energy versus units of wavelength.

The broadening is unequivocally Doppler broadening as discussed in References #49 and # 37. The microwave-field broadening cited in Examiner's Luque et al paper is six orders of magnitude too low to account for the broadening reported by Applicant (e.g. Ref. #49). In fact, the point of the paper by Luque et al. was the very technically difficult Doppler-free two-photon excitation to show the microwave effect which can not otherwise be observed since it is overwhelmed by the Doppler broadening as also pointed out in the strongly emphasized paper of Jovicevic et al (S. Jovicevic, M. Ivkovic, N. Konjevic, S. Popovic, L. Vuskovic, J. Appl. Phys. 95, 24 (2004)).

In addition, the magnitude of the broadening varies as expected based on the particular catalyst and the duration of the reaction with more energetic transitions occurring with time as discussed in

51. **J. Phillips, C-K Chen, R. Mills, "Evidence of catalytic Production of Hot Hydrogen in RF Generated Hydrogen/Argon Plasmas", IEEE Transactions on Plasma Science, submitted.**

    J. Phillips, Distinguished National Laboratory Professor at Los Alamos National Laboratory and University of New Mexico, performed verification studies of line broadening in catalysis plasmas. This is the third in a series of papers by our team on apparently anomalous Balmer series line broadening in hydrogen containing RF generated, low pressure (< 600 mTorr) plasmas. In this paper the selective broadening of the atomic hydrogen lines in pure H2 and Ar/H2 mixtures in a large "GEC" cell (36 cm length X 14 cm ID) was mapped as a function of position, H2/Ar ratio, time, power, and pressure. Several observations regarding the selective line broadening were particularly notable as they are unanticipated on the basis of earlier models. First, the anomalous broadening of the Balmer lines was found to exist throughout the plasma, and not just in the region between the electrodes. Second, the broadening was consistently a complex function of the operating parameters particularly gas composition (highest in pure H2) position, power and pressure. Clearly not anticipated by earlier models were the

findings that under some conditions the highest concentration of "hot" (>10 eV) hydrogen was found at the entry end, and not in the high field region between the electrodes and that in other conditions, the hottest H was at the (exit) pump (also grounded electrode) end. Third, excitation and electron temperatures were less than one eV in all regions of the plasma not directly adjacent (>1mm) to the electrodes, providing additional evidence that the energy for broadening, contrary to standard models, is not obtained from the field. Fourth, in contrast to our earlier studies of hydrogen/helium and water plasmas, we found that in some conditions 98% of the atomic hydrogen was in the "hot" state throughout the GEC cell. Virtually every operating parameter studied impacted the character of the hot H atom population, and clearly second and third order effects exist, indicating a need for experimental design. Some non-field mechanisms for generating hot hydrogen atoms, specifically those suggested by Mills' CQM model, are outlined.

Section 45

Examiner Souw commits further errors in his analysis on page 8 of the Appendix:

(d.4) Applicant (mis)interpret the observed linewidth as a Doppler width, for which there is no justification, but --at most-- only a presumption or tentative suggestion. To recapitulate, Applicant came to the 10-100 eV number by firstly presuming the observed linewidth as being entirely due to Doppler effect. Secondly, Applicant then converts the frequency shift (100 GHz) corresponding to the observed line broadening into atomic velocity, then finally multiplying the square of this velocity by the atomic mass to derive the suggested 10-100 eV translational kinetic energy (which is totally of different nature than the 0.45 meV blur or spread of unknown origin in the oscillation kinetic energy of a radiating electron transition dipole, as recited above). Such a derivation is based on a sequence of presumptions that may be partially or even entirely incorrect. Although Doppler effect is omnipresent, there is no justification for assuming the observed line broadening as being entirely due to the Doppler effect. The factual evidence only shows a 0.16 nm line width as observed by Luggenhoelscher, comparable to a 0.27 nm claimed by Applicant. There is no evidence that Applicant's 0.27 nm can be correlated to a translational kinetic energy of">l0 eV" or ">100 eV", or whatsoever, by presuming the linewidth were entirely caused by ***"hot** H"*, as postulated by Applicant.

The broadening is unequivocally Doppler broadening as stated in the Examiner's' cited paper, N. Cvetanovic, M. M. Kuraica and N. Konjevic, J. Appl. Phys. 97, 33302 (2005), as well as those given in Section 43 above. The Examiner is

oblivious to the body of evidence that he even cites that identifies the observations of line broadening as due to hot H with energies in the range of 10-300 eV.

The Examiner cites Applicant's paper:

49. R. L. Mills, P. Ray, B. Dhandapani, J. He, "Comparison of Excessive Balmer α Line Broadening of Inductively and Capacitively Coupled RF, Microwave, and Glow Discharge Hydrogen Plasmas with Certain Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. 3, (2003), pp. 338-355.

The introduction is copied below to help educate the Examiner on the proper background in this field on which he so heavily relies for his rejections:

I. INTRODUCTION

Glow discharge devices have been developed over decades as light sources, ionization sources for mass spectroscopy, excitation sources for optical spectroscopy, and sources of ions for surface etching and chemistry [1-3]. A Grimm-type glow discharge is a well established excitation source for the analysis of conducting solid samples by optical emission spectroscopy [4-6]. But, only in the last decade has extensive spectroscopic characterization been conducted that has led to some puzzling observations. For example, M. Kuraica and N. Konjevic [7], Videnovic et al. [8], and others [9-12] have characterized mixed hydrogen-argon plasmas by determining the excited hydrogen atom energies from measurements of the line broadening of one or more of the Balmer α, β, and γ lines of atomic hydrogen at 656.28, 486.13, and 434.05 nm, respectively. They found that the Balmer lines were extremely broadened and explained the phenomenon primarily in terms of Doppler broadening due to the acceleration of charges such as H^+, H_2^+, and H_3^+ in the high fields (e. g. over $10\ kV/cm$) present in the cathode fall region.

Djurovic and Roberts [10] recorded the spectral and spatial profiles of Balmer α line emission from low pressure RF (13.56 MHz) discharges in $H_2 + Ar$ mixtures in a direction normal to the electric field. The introduction of Ar in a pure H_2 plasma increased the number of fast neutral atoms as evidenced by the intensity of the broad component of a two-component Doppler-broadened Balmer α line profile. Independent of cell position or direction, the average energy of a wide profile component was 23.8 eV for voltages above 100 V, and the average energy of a slow component was 0.22 eV. The mechanism proposed by Djurovic and Roberts is the production of fast H atoms from electric field accelerated H_2^+. The explanation of the role of Ar in the production of a large number of excited hydrogen atoms in the $n = 3$ state, as well as raising their energy for a given pressure and applied RF voltage, is that collisions with

Ar in the plasma sheath region enhances the production of fast H_2 from accelerated H_2^+. The fast H_2 then undergoes dissociation to form fast H which may then be excited locally to the $n = 3$ state by a further collision with Ar. The local excitation is a requirement since the atomic lifetime of the hydrogen $n = 3$ state is approximately $10^{-8}\ s$, and the average velocity of the hydrogen atoms is $< 10^5$ m/s. Thus, the distance traveled must be less that 0.001 m. A number of additional mechanisms have been proposed in order to explain the excessive Doppler broadening of the Balmer α line in argon-hydrogen DC or RF driven glow discharge plasmas all of which ultimately depend on electric field acceleration of hydrogen positive ions.

Hydrogen mixed with certain noble gases has also been observed to give unexpected hydrogen emission intensity. For example, based on its unusually intense emission, a neon-hydrogen microhollow cathode glow discharge has been proposed as a source of predominantly Lyman α radiation. Kurunczi, Shah, and Becker [13] observed intense emission of Lyman α and Lyman β radiation at 121.6 nm and 102.5 nm, respectively, from microhollow cathode discharges in high-pressure Ne (740 Torr) with the addition of a small amount of hydrogen (up to 3 Torr). With essentially no molecular emission observed, Kurunczi et al. attributed the anomalous Lyman α emission to the near-resonant energy transfer between the Ne_2^* excimer and H_2 which leads to formation of $H(n = 2)$ atoms, and attributed the Lyman β emission to the near-resonant energy transfer between excited Ne^* atoms (or vibrationally excited neon excimer molecules) and H_2 which leads to formation of $H(n = 3)$ atoms. Despite the emission characterization of this source, data is lacking about plasma parameters.

A new low-electric field plasma source has been developed that is based on a resonant energy transfer of an integer of $27.2\ eV$ from atomic hydrogen to a catalyst capable of accepting the energy. It operates by incandescently heating a hydrogen dissociator and a catalyst to provide atomic hydrogen and gaseous catalyst, respectively, such that the catalyst reacts with the atomic hydrogen to produce a plasma called a resonant transfer (rt)-plasma. It was extraordinary, that intense vacuum ultraviolet (VUV) emission was observed [14-16] at low temperatures (e.g. $\approx 10^3\ K$) from atomic hydrogen and certain atomized elements or certain gaseous ions which singly or multiply ionize at integer multiples of the potential energy of atomic hydrogen, $27.2\ eV$ that comprise catalysts. The only pure elements that were observed to emit VUV were those wherein the ionization of t electrons from an atom to a continuum energy level is such that the sum of the ionization energies of the t electrons is approximately $m \cdot 27.2\ eV$ where t and m are each an integer. For example, K, Cs, Sr, Sr^+, and Rb^+ each ionize at integer multiples of the potential energy of atomic hydrogen and caused emission as predicted; whereas, the chemically similar atoms, Na, Mg, and Ba, do not ionize at integer

multiples of the potential energy of atomic hydrogen and caused no emission as predicted as well. The theory and balanced resonant energy transfer reactions have been given previously [14-15, 17] or are in press [16, 18].

In addition, Ar^+ and He^+ each ionize at an integer multiple of the potential energy of atomic hydrogen; thus, a discharge with one or more of Sr^+, Ar^+, and He^+ present with hydrogen was anticipated to form an rt-plasma. Mills and Nansteel [14] have reported that rt-plasmas formed with Sr^+ and Ar^+ catalysts at 1% of the theoretical or prior known voltage requirement with a light output per unit power input of up to 8600 times that of control standard light sources. Characteristic emission was observed from a continuum state of Ar^{2+} which confirmed the resonant nonradiative energy transfer of $27.2\ eV$ from atomic hydrogen Ar^+ [19]. Predicted emission lines were observed from helium-hydrogen [17-18, 20] as well as strontium-argon-hydrogen plasmas [19] that supported the rt-plasma mechanism.

He^+ ionizes at $54.417\ eV$ which is $2 \cdot 27.2\ eV$, and novel VUV emission lines were observed from microwave and glow discharges of helium with 2% hydrogen [20]. The observed energies were $q \cdot 13.6\ eV$ ($q = 1,2,3,4,6,7,8,9,\ or\ 11$) or these discrete energies less $21.2\ eV$ corresponding to inelastic scattering of these photons by helium atoms due to excitation of $He\,(1s^2)$ to $He\,(1s^1 2p^1)$. These lines can be explained by the resonant transfer of 2 times $27.2\ eV$, with He^+ to He^{2+} [20].

It was anticipated that glow, microwave, and RF discharges could each also provide atomic hydrogen and a catalyst to form an rt-plasma. In the present paper, we report studies to further characterize the plasma parameters observed in such rt-plasmas as well as the difference between rt-plasmas created by glow, microwave, and inductively and capacitively coupled RF discharge sources. The line broadening and intensity of the 656.3 nm Balmer α line was measured to determine the excited hydrogen atom energy and the H concentration in plasmas of hydrogen with a catalyst as well as plasmas comprising hydrogen with chemically similar controls that did not provide gaseous atoms or ions having electron ionization energies which are a multiple of $27.2\ eV$. In addition, the electron temperature T_e was measured on microwave and inductively coupled RF plasmas using the ratio of the intensity I of two visible noble gas lines in two quantum states that were close in wavelength such as the ratio $I(He\ 501.6\ nm\ line)/I(He\ 492.2\ nm\ line)$ and the ratio $I(Ar\ 377.03\ nm\ line)/I(Ar\ 420.06\ nm\ line)$ for plasmas having helium and argon, respectively, alone or as a mixture with hydrogen.

We report here, that anomalous line broadening of H_α was observed as predicted in specific rt-plasmas gas mixtures but not in others where the resonant transfer condition was not satisfied. Moreover, as discussed *supra*, a number of mechanisms have been proposed in order to explain the excessive Doppler broadening of the Balmer α line in

argon-hydrogen high voltage DC or RF driven glow discharge plasmas that are all ultimately based on acceleration in a high electric field. We show that the experimental evidence from several rt-plasma sources does not support such a mechanism. These are shown to be untenable based on additional data and based on our results with microwave plasmas where no strong applied electric field (e. g. over $10\ kV/cm$) or cathode fall region is present. Moreover, we anticipate the observed results based on the rt-plasma mechanism.

Section 46

Examiner Souw's erroneous analysis continues with the following arguments on pages 8-9 of his Appendix:

> Thus, a correlation of the observed line broadening anomaly with hydrogen translational kinetic energy, or velocity, or Doppler effect, is NOT a FACT, but only a suggestion or preposition, as correctly stated by Kovacevic et a!. [6] by using the wording "probably" and "possible process", seeing that there are still other mechanisms also probable. As a matter of fact, the plasma sheath effect proposed by Kovacevic et al. in [6] sounds even much more plausible than Applicant's postulated hydrino. While it is not the job of the PTO to participate in a scientific debate, a plausibility consideration is here appropriate. Kovacevic's plasma sheath is more plausible, simply because plasma sheath is a well known fact **[7]** routinely observed by many other researchers in a large number of unrelated phenomena, as opposed to "hydrino", whose existence is unproven by any evidence, and even more, in violation of known laws of physics, while also being postulated under an incredibly large number of mathematical flaws and conceptual misunderstanding.

Again, the Examiner is obviously confused. The broadening is unequivocally Doppler as cited by many references in addition to those of Applicant. See:

S. Jovicevic, M. Ivkovic, N. Konjevic, S. Popovic, L. Vuskovic, J. Appl. Phys. 95, 24 (2004).
N. Cvetanovic, M. M. Kuraica and N. Konjevic, J. Appl. Phys. 97, 33302 (2005).

and many others:

1. M. Kuraica, N. Konjevic, "Line shapes of atomic hydrogen in a plane-cathode abnormal glow discharge", Physical Review A, Volume 46, No. 7, October (1992), pp. 4429-4432.
2. M. Kuraica, N. Konjevic, M. Platisa and D. Pantelic, *Spectrochimica*

Acta Vol. 47, 1173 (1992).
3. I. R. Videnovic, N. Konjevic, M. M. Kuraica, "Spectroscopic investigations of a cathode fall region of the Grimm-type glow discharge", Spectrochimica Acta, Part B, Vol. 51, (1996), pp. 1707-1731.
4. S. Alexiou, E. Leboucher-Dalimier, "Hydrogen Balmer-α in dense plasmas", Phys, Rev. E, Vol. 60, No. 3, (1999), pp. 3436-3438.
5. S. Djurovic, J. R. Roberts, "Hydrogen Balmer alpha line shapes for hydrogen-argon mixtures in a low-pressure rf discharge", J. Appl. Phys., Vol. 74, No. 11, (1993), pp. 6558-6565.
6. S. B. Radovanov, K. Dzierzega, J. R. Roberts, J. K. Olthoff, Time-resolved Balmer-alpha emission from fast hydrogen atoms in low pressure, radio-frequency discharges in hydrogen", Appl. Phys. Lett., Vol. 66, No. 20, (1995), pp. 2637-2639.
7. S. B. Radovanov, J. K. Olthoff, R. J. Van Brunt, S. Djurovic, "Ion kinetic-energy distributions and Balmer-alpha (H_α) excitation in $Ar - H_2$ radio-frequency discharges", J. Appl. Phys., Vol. 78, No. 2, (1995), pp. 746-757.
8. R. L. Mills, P. Ray, "Substantial Changes in the Characteristics of a Microwave Plasma Due to Combining Argon and Hydrogen", New Journal of Physics, www.njp.org, Vol. 4, (2002), pp. 22.1-22.17.
9. R. L. Mills, P. Ray, B. Dhandapani, R. M. Mayo, J. He, "Comparison of Excessive Balmer α Line Broadening of Glow Discharge and Microwave Hydrogen Plasmas with Certain Catalysts", J. of Applied Physics, Vol. 92, No. 12, (2002), pp. 7008-7022.
10. R. Mills and M. Nansteel, P. Ray, "Argon-Hydrogen-Strontium Discharge Light Source", IEEE Transactions on Plasma Science, Vol. 30, No. 2, (2002), pp. 639-653.
11. R. Mills, M. Nansteel, and P. Ray, "Excessively Bright Hydrogen-Strontium Plasma Light Source Due to Energy Resonance of Strontium with Hydrogen", J. of Plasma Physics, Vol. 69, (2003), pp. 131-158.
12. R. Mills and M. Nansteel, P. Ray, "Bright Hydrogen-Light Source due to a Resonant Energy Transfer with Strontium and Argon Ions", New Journal of Physics, Vol. 4, (2002), pp. 70.1-70.28.
13. R. L. Mills, P. Ray, B. Dhandapani, J. He, "Comparison of Excessive Balmer α Line Broadening of Inductively and Capacitively Coupled RF, Microwave, and Glow Discharge Hydrogen Plasmas with Certain Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. (2003), pp. 338-355.
14. R. L. Mills, P. Ray, "Extreme Ultraviolet Spectroscopy of Helium-Hydrogen Plasma", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542.
15. R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "New Power Source from Fractional Quantum Energy Levels of Atomic Hydrogen that Surpasses Internal Combustion", J Mol. Struct., Vol. 643, No. 1-3, (2002), pp. 43-54.

16. R. Mills, P. Ray, R. M. Mayo, "CW H I Laser Based on a Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Group I Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. 2, (2003), pp. 236-247.
17. R. L. Mills, P. Ray, "Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Catalysts", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1504-1509.

Doppler broadening is due to kinetic energy as stated in those papers. What is argued by others is that the origin of the broadening is electric-field acceleration. Applicant has shown that this can not be the explanation since among other observations, the line broadening is found undiminished in regions of the cell where there is no measured electric field, the effect is independent of direction of observation with respect to the field, it is time dependent, is selective for H, only occurs in cells having Applicant's predicted catalysts to form hydrino, and occurs in cells with no or very low fields such as microwave plasmas and filament (rt-plasma) cells. These points and the supporting references appear in Section 19 of Applicant's main response and others above.

Furthermore, SQM violates physical laws; whereas, CQM is derived from those laws as pointed out below. The existence of hydrino is confirmed overwhelming by the experimental evidence, such as that summarized in Section 2 of Applicant's main response and in Section 28 above.

<u>Section 47</u>

Examiner Souw further argues without merit on page 9 of the Appendix:

> Thus, while 0.16 nm and 0.27 nm are scientific facts, Applicant's "10 eV or 100 eV **<u>hot H</u>**" is ***not*** a scientific ***fact***, since the relation to translational kinetic velocity or energy (Doppler effect) of the radiating atom is only presumed without valid evidence (see Kovacevic [6]). Valid as hard evidence would be, e.g., a Doppler-free laser spectroscopic measurement, such as what was done by the Examiner in previously cited Ref.[8]. This would indisputably separate the Doppler effect from the homogeneous line broadening, the latter including Stark effects and microwave effects. Without such a hard evidence, Applicant's claim of"10 *eV or 100 eV hot H"* remains a hypothesis. Furthermore, such a claim does not have any relevance to, let alone a justification for, the existence of "hydrino". It is thus concluded, Applicant's claim that the observed

anomalous hydrogen line broadening were due to "hydrino" remains scientifically *incredible*, justifying the previously applied § 101 and § 112/¶.1 claim rejections.

The broadening is unequivocally Doppler broadening as given in the references cited in Section 46 above. The hydrino explanation is the only one consistent with all of the data, as discussed above in Section 46, for example. For a specific independent analysis, see:

51. **J. Phillips, C-K Chen, R. Mills, "Evidence of catalytic Production of Hot Hydrogen in RF Generated Hydrogen/Argon Plasmas", IEEE Transactions on Plasma Science, submitted.**
    J. Phillips, Distinguished National Laboratory Professor at Los Alamos National Laboratory and University of New Mexico, performed verification studies of line broadening in catalysis plasmas. This is the third in a series of papers by our team on apparently anomalous Balmer series line broadening in hydrogen containing RF generated, low pressure (< 600 mTorr) plasmas. In this paper the selective broadening of the atomic hydrogen lines in pure H2 and Ar/H2 mixtures in a large "GEC" cell (36 cm length X 14 cm ID) was mapped as a function of position, H2/Ar ratio, time, power, and pressure. Several observations regarding the selective line broadening were particularly notable as they are unanticipated on the basis of earlier models. First, the anomalous broadening of the Balmer lines was found to exist throughout the plasma, and not just in the region between the electrodes. Second, the broadening was consistently a complex function of the operating parameters particularly gas composition (highest in pure H2) position, power and pressure. Clearly not anticipated by earlier models were the findings that under some conditions the highest concentration of "hot" (>10 eV) hydrogen was found at the entry end, and not in the high field region between the electrodes and that in other conditions, the hottest H was at the (exit) pump (also grounded electrode) end. Third, excitation and electron temperatures were less than one eV in all regions of the plasma not directly adjacent (>1mm) to the electrodes, providing additional evidence that the energy for broadening, contrary to standard models, is not obtained from the field. Fourth, in contrast to our earlier studies of hydrogen/helium and water plasmas, we found that in some conditions 98% of the atomic hydrogen was in the "hot" state throughout the GEC cell. Virtually every operating parameter studied impacted the character of the hot H atom population, and clearly second and third order effects exist, indicating a need for experimental design. Some non-field mechanisms for generating hot hydrogen atoms, specifically those suggested by Mills' CQM model, are outlined.

The line broadening result is consistent with at least 11 other conjugate parameters measured on Applicant's plasma reactors, as shown in Section 2 of Applicant's main response and in Section 28 above.

Section 48

On pages 9-10 of the Appendix, Examiner Souw further errs in stating that:

(d.5) Applicant's method of estimating the 10-100 eV kinetic energy will now be applied to the Examiner's 0.16 nm linewidth (measured as full width at half maximum, FWHM), showing the sequence of presumptions thereby made, without regards of the validity of Applicant's unverified Doppler presumption. Firstly, the linewidth 3.7 cm^{-1} or 0.16 nm is converted into atomic velocity $<v>$ according to the well known Doppler-shift formula äë/ë=v/c, presuming firstly there is no other contributing effects, and secondly, that the homogenous linewidth is negligible. By taking account for a factor originating from the relationship between a presumed Maxwell-Boltzman velocity distribution and the definition of FWHM Doppler linewidth, one easily obtains a 1-dimensional average hydrogen translational linear velocity $<v_Z>$. Presuming further that the velocity distribution is isotropic and 3-dimensional, this translational linear velocity corresponds to an average (3-dimensional) translational kinetic energy of $KE=m<v^2>/2$, where m is the mass of atomic hydrogen (=1.67·10^{-24} gm). Ready-to-use formulas that may be taken for the above estimates are, for example, äë/ë=äí/í=(1/c)??(8kT?ln2/m) [9] and $KE=m<v^2>/2=3kT/2$ [10], in terms of the temperature T as a redundant parameter. One of ordinary skill in the art easily obtains a translational kinetic energy of ***KE=15.2 eV,*** which properly corresponds to the 0.16 nm line width under the presumptions described above.

We see, this **15.2 eV** kinetic energy is very much comparable to Applicant's **10-100 eV**, just in the same manner as 0.16 nm is comparable to 0.27 nm. Thus, by writing a directly measured linewidth 3.7 cm^{-1} in an alternative unit, 0.45 meV (which itself does not make sense), and then comparing the latter with a hypothesized 10 eV translational kinetic energy, not only is Applicant making an improper comparison, but Applicant is also violating a conceptual fundament of physics, like comparing "apples" with "oranges".

As shown in Section 44 above, the 3.7 cm-1 corresponds to an energy of 4.5 meV. The Examiner does not calculate the Doppler energy correctly according to the following references:

S. Jovicevic, M. Ivkovic, N. Konjevic, S. Popovic, L. Vuskovic, J. Appl. Phys. 95, 24 (2004).
N. Cvetanovic, M. M. Kuraica and N. Konjevic, J. Appl. Phys. 97, 33302 (2005).

and many others:

1. M. Kuraica, N. Konjevic, "Line shapes of atomic hydrogen in a plane-cathode abnormal glow discharge", Physical Review A, Volume 46, No. 7, October (1992), pp. 4429-4432.
2. M. Kuraica, N. Konjevic, M. Platisa and D. Pantelic, *Spectrochimica Acta* Vol. 47, 1173 (1992).
3. I. R. Videnovic, N. Konjevic, M. M. Kuraica, "Spectroscopic investigations of a cathode fall region of the Grimm-type glow discharge", Spectrochimica Acta, Part B, Vol. 51, (1996), pp. 1707-1731.
4. S. Alexiou, E. Leboucher-Dalimier, "Hydrogen Balmer-α in dense plasmas", Phys, Rev. E, Vol. 60, No. 3, (1999), pp. 3436-3438.
5. S. Djurovic, J. R. Roberts, "Hydrogen Balmer alpha line shapes for hydrogen-argon mixtures in a low-pressure rf discharge", J. Appl. Phys., Vol. 74, No. 11, (1993), pp. 6558-6565.
6. S. B. Radovanov, K. Dzierzega, J. R. Roberts, J. K. Olthoff, Time-resolved Balmer-alpha emission from fast hydrogen atoms in low pressure, radio-frequency discharges in hydrogen", Appl. Phys. Lett., Vol. 66, No. 20, (1995), pp. 2637-2639.
7. S. B. Radovanov, J. K. Olthoff, R. J. Van Brunt, S. Djurovic, "Ion kinetic-energy distributions and Balmer-alpha (H_α) excitation in $Ar-H_2$ radio-frequency discharges", J. Appl. Phys., Vol. 78, No. 2, (1995), pp. 746-757.
8. R. L. Mills, P. Ray, "Substantial Changes in the Characteristics of a Microwave Plasma Due to Combining Argon and Hydrogen", New Journal of Physics, www.njp.org, Vol. 4, (2002), pp. 22.1-22.17.
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to a Resonant Energy Transfer with Strontium and Argon Ions", New Journal of Physics, Vol. 4, (2002), pp. 70.1-70.28.
13. R. L. Mills, P. Ray, B. Dhandapani, J. He, "Comparison of Excessive Balmer α Line Broadening of Inductively and Capacitively Coupled RF, Microwave, and Glow Discharge Hydrogen Plasmas with Certain Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. (2003), pp. 338-355.
14. R. L. Mills, P. Ray, "Extreme Ultraviolet Spectroscopy of Helium-Hydrogen Plasma", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542.
15. R. L. Mills, P. Ray, B. Dhandapani, M. Nansteel, X. Chen, J. He, "New Power Source from Fractional Quantum Energy Levels of Atomic Hydrogen that Surpasses Internal Combustion", J Mol. Struct., Vol. 643, No. 1-3, (2002), pp. 43-54.
16. R. Mills, P. Ray, R. M. Mayo, "CW H I Laser Based on a Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Group I Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. 2, (2003), pp. 236-247.
17. R. L. Mills, P. Ray, "Stationary Inverted Lyman Population Formed from Incandescently Heated Hydrogen Gas with Certain Catalysts", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1504-1509.

Section 49

Examiner Souw further argues on pages 10-11 of the Appendix that:

> (d.6) Applicant's lengthy discussion on various broadening mechanism conducted on pgs. 139-142 is well known in the art, and is not argued by the Examiner. Disputed is here the interpretation of the observed broadening as being due to atomic velocity, or translational kinetic energy, or Doppler effect. The latter is no more than a probable mechanism, as correctly stated by Kovacevic [6] by using the wording "probably" and "possible process". There are many other possibilities that would also explain the observed effect, e.g., the well known microwave effect proposed by other researchers, e.g., Luggenhoelscher, as cited previously. Applicant is totally silent about this microwave effects.

These statements are not true. The selective H broadening is unequivocally Doppler broadening as stated by scores of researchers over decades of study. Applicant has discovered the origin of the predicted effect in Applicant's rt-plasma cells as due to the energy released as hydrogen undergoes transitions to lower-energy states.

Section 50

Examiner Souw further asserts without basis on page 11 of his Appendix that:

> (e) Applicant's statement on pg.139, lines 1-3, that *"Stark broadening of hydrogen lines can not be measured at low electron densities ..."*, is scientifically inaccurate. Stark broadening, or any homogeneous line broadening, such as due to microwave effects, can well be accurately measured (to 10^{-5} nm or even better), e.g., by means of Doppler-free Laser Spectroscopy, as demonstrated by the Examiner in his own work cited previously [8]. Such a measurement would have been scientifically acceptable as hard evidence for the Doppler effect (but not for "hydrino"), since the Doppler-free technique would be able to cancel out the Doppler effect, thereby measuring only the intrinsic/homogeneous broadening (e.g., natural broadening, Stark broadening, both static and dynamic, AC Stark effect, microwave effects, etc.).

These effects are negligible compared to the observed >0.1 nm Gaussian broadening corresponding to the Doppler effect.

From Ref. #49. R. L. Mills, P. Ray, B. Dhandapani, J. He, "Comparison of Excessive Balmer α Line Broadening of Inductively and Capacitively Coupled RF, Microwave, and Glow Discharge Hydrogen Plasmas with Certain Catalysts", IEEE Transactions on Plasma Science, Vol. 31, No. (2003), pp. 338-355:

> We have assumed that Doppler broadening due to thermal motion was the dominant source to the extent that other sources may be neglected. To justify this assumption, each source is now considered. In general, the experimental profile is a convolution of a Doppler profile, an instrumental profile, the natural (lifetime) profile, Stark profiles, Van der Waals profiles, a resonance profile, and fine structure. The instrumental half-width is measured to be $\pm 0.006\ nm$. The natural half-width of the Balmer α line given by Djurovic and Roberts [10] is $1.4\ X\ 10^{-4}\ nm$ which is negligible. The fine structure splitting is also negligible.
>
> Stark broadening of hydrogen lines in plasmas can not be measured at low electron densities using conventional emission or absorption spectroscopy because it is hidden by Doppler broadening. In the case of the Lyman α line, the Stark width exceeds the Doppler width only at $n_e > 10^{17}\ cm^{-3}$ for temperatures of about $10^4\ K$ [34]. Gigosos and Cardenoso [35] give the observed Balmer α Stark broadening for plasmas of hydrogen with helium or argon as a function of the electron temperature and density. For example, the Stark broadening of the Balmer α line recorded on a

$H + He^{+}$ plasma is only 0.033 nm with $T_e = 20{,}000\ K$ and $n_e = 1.4\ X\ 10^{14}\ cm^{-3}$.

The relationship between the Stark broadening $\Delta\lambda_S$ of the Balmer β line in nm, the electron density n_e in m^{-3}, and the electron temperature T_e in K is

$$\log n_e = C_0 + C_1 \log(\Delta\lambda_S) + C_2[\log(\Delta\lambda_S)]^2 + C_3 \log(T_e) \tag{5}$$

where $C_0 = 22.578$, $C_1 = 1.478$, $C_2 = -0.144$, and $C_3 = 0.1265$ [36]. From Eq. (5), to get a Stark broadening of only 0.1 nm with $T_e = 9000\ K$, an electron density of about $n_e \sim 3\ X\ 10^{15}\ cm^{-3}$ is required, compared to that of the argon-hydrogen plasma of $< 10^{9}\ cm^{-3}$ determined using a compensated Langmuir probe, over six orders of magnitude less. Regional maxima in electron densities that could give rise to Stark broadening was eliminated as a possibility. The measured electron densities did not exceed $10^{9}\ cm^{-3}$, and the axial variation was weak, showing less than a factor of two change throughout the brightest region of the plasma. The high mass diffusivity of all of the species present made it unlikely that a large density gradient existed anywhere in the plasma at steady state. This result was also evident by the good fit to a Gaussian profile recorded on the argon-hydrogen plasma rather than a Voigt profile as shown in Figure 10. In addition, the line broadening for Balmer β, γ, and δ was comparable to that of Balmer α; whereas, an absence of broadening beyond the instrument width was observed for the lines of argon or helium species such as the 667.73 nm and 591.2 nm Ar I lines and 667.816 nm and 587.56 nm He I lines. Thus, the Stark broadening was also insignificant.

A linear Stark effect arises from an applied electric field that splits the energy level with principal quantum number n into $(2n-1)$ equidistant sublevels. The magnitude of this effect given by Videnovic et al. [8] is about $2\ X\ 10^{-2}\ nm / kV \cdot cm^{-1}$. No appreciable applied electric field was present in our study; thus, the linear Stark effect should be negligible. The absence of broadening of the noble gas lines and the hydrogen lines of the controls confirmed the absence of a strong electric field. No charged resonator cavity surfaces were present since the plasmas was contained in a quartz tube with the cavity external to the tube. A microwave E-mode field does exist in the Evenson cavity that is a function of the reflected power [37-38], and the catalysis reaction is dependent on this field as discussed previously [39]. However, there is no cathode fall region and the magnitude of the microwave field is comparably much less than that found in the cathode fall region of a glow discharge cell.

To investigate whether the rt-plasmas of this study were optically thin or thick at a given frequency ω, the effective path length $\tau_\omega(L)$ was calculated from

$$\tau_\omega(L) = \kappa_\omega L \qquad (5)$$

where L is the path length and κ_ω is the absorption coefficient given by

$$\kappa_\omega = \sigma_\omega N_H \qquad (7)$$

where σ_ω is the absorption cross section and N_H is the number density of the absorber. For optically thin plasmas $\tau_\omega(L) < 1$, and for optically thick plasmas $\tau_\omega(L) > 1$. The absorption cross section for Balmer α emission is $\sigma = 1\,X10^{-16}\ cm^2$ [40]. By methods discussed previously [41-42], an estimate of the n=2 H atom density based on Lyman line intensity is $\sim 1\,X10^{8}\,cm^{-3}$. Thus, for a plasma length of $5\ cm$, $\tau_\omega(5\ cm)$ for Balmer α is

$$\tau_\omega(5\ cm) = \kappa_\omega L = \left(1\,X\,10^{-16}\ cm^2\right)\left(1\,X\,10^{8}\ cm^{-3}\right)\left(5\ cm\right) = 5\,X\,10^{-8} \qquad (8)$$

Since $\tau_\omega(5) <<< 1$, the argon-hydrogen plasmas were optically thin; so, the self absorption of 656.3 nm emission by n=2 state atomic hydrogen may be neglected as a source of the observed broadening.

As discussed above, an estimate based on emission line profiles places the total H atom density of the argon-hydrogen plasma at $\sim 3.5\,X10^{14}\ cm^{-3}$. Since this is overwhelmingly dominated by the ground state, $N_H = 3.5\ X10^{14}\ cm^{-3}$ will be used. Usually, the atomic hydrogen collisional cross section in plasmas is on the order of $10^{-18}\ cm^2$ [43]. Thus, for $N_H = 3.5\ X10^{14}\ cm^{-3}$, collisional or pressure broadening is negligible.

Section 51

Examiner Souw's erroneous analysis continues on pages 11-12 of the Appendix:

(f) Applicant's argument on pg.140-142 regarding Luque's and Luggenhoelscher's references has no merit, not only because the references are not cited by the Examiner to refute Applicant's incorrect claim of the Doppler effect and "hydrino" (this is accomplished by Kovacevic's [6] by virtue of the plasma sheath effect), but instead, to compare with the 0.27 nm line broadening measured by Applicant (see previous recitation from Applicant's paper). However, irrespective of the validity of Applicant's unverified Doppler assumption, a proper conversion of Luggenhoelscher's line broadening leads to a comparable magnitude (15.2 eV) with Applicant's claimed 10 eV kinetic energy, as previously demonstrated by the Examiner. Any further argument over line broadening in applicant's data of record will be considered unpersuasive for the reasons given in section I.B.3.d(5).

Examiner Souw's arguments are completely unfounded based on his lack of understanding that 3.7 cm-1 corresponds to only 4.5 meV, a trivial effect as discussed in Sections 42-44 above. His position that microwave fields have such an effect in Applicant's cells is refuted even by the paper cited by the Examiner:

> S. Jovicevic, M. Ivkovic, N. Konjevic, S. Popovic, L. Vuskovic, J. Appl. Phys. 95, 24 (2004).

Section 52

Examiner Souw summarizes his erroneous analysis of Applicant's scientific evidence on page 12 of his Appendix by further arguing:

(C) CONCLUSION

> Not a single independent third party (one that is not funded by or in collaboration with applicant) has been able to confirm Applicant's claim(s). Therefore, serious doubts are raised as to the scientific reproducibility of Applicant's results. This situation is very similar to cold fusion, the latter having ultimately ended up with a final dismissal by the scientific community. Since Applicant's invention violates what is conventionally accepted in science, it is not patentable. Such an "invention" is also not useful, since it cannot be reproduced and used by others. Therefore, a rejection under § 101 and § 112/¶.1 is here proper.

The Examiner could not be more wrong. Applicant's results predicted by physical laws have been published in over 60 peer-reviewed journal articles and are disclosed in 112 articles, as summarized in the section entitled "Lower-Energy Hydrogen Experimental Data". Applicant's results have been replicated by many top laboratories as given in 51 independent test reports and papers summarized in the section entitled "Independent Test Results."

Section 53

Examiner Souw further concludes without adequate basis on page 12 of his Appendix that:

> In summary, Applicant's claims on hydrino-based processes have neither a credible experimental confirmation nor a scientific basis (see also Part IIof this Appendix: Theoretical).

In summary, the Examiner has not presented a single viable alternative to challenge Applicant's overwhelming body of evidence that confirms the claimed reaction of atomic hydrogen to lower-energy states and the existence of the claimed hydrino.

Studies that experimentally confirm a novel reaction of atomic hydrogen which produces hydrogen in fractional quantum states that are at lower energies than the traditional "ground" ($n = 1$) state, a chemically generated or assisted plasma (rt-plasma), and produces novel hydride compounds are summarized in the section entitled, "Lower-Energy Hydrogen Experimental Data" and include including:

extreme ultraviolet (EUV) spectroscopy,[13]
characteristic emission from catalysis and the hydride ion products,[14]
lower-energy hydrogen emission,[15]
plasma formation,[16]
Balmer α line broadening,[17]
population inversion of hydrogen lines,[18]
elevated electron temperature,[19]
anomalous plasma afterglow duration,[20]
power generation,[21]
excessive light emission,[22] and
analysis of chemical compounds.[23]

Section 54

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[13] Reference Nos. 11-16, 20, 24, 27-29, 31-36, 39, 42-43, 46-47, 50-52, 54-55, 57, 59, 63, 65-68, 70-76, 78-79, 81, 83, 85, 86, 89, 91-93, 95-96, 98, 101, 104, 108-112.

[14] Reference Nos. 24, 27, 32, 39, 42, 46, 51-52, 55, 57, 68, 72-73, 81, 89, 91, 108.

[15] Reference Nos. 14, 28-29, 33-36, 50, 63, 67, 70-71, 73, 75-76, 78-79, 86-87, 90, 92, 93, 98, 101, 104, 110-112.

[16] Reference Nos. 11-13, 15-16, 20, 24, 27, 32, 39, 42, 46-47, 51-52, 54-55, 57, 72, 81, 89, 91-93, 108, 109.

[17] Reference Nos. 16, 20, 30, 33-37, 39, 42-43, 49, 51-52, 54-55, 57, 63-65, 68-69, 71-74, 81-85, 88-89, 91, 92, 93, 95-97, 105, 108, 109.

[18] Reference Nos. 39, 46, 51, 54, 55, 57, 59, 65-66, 68, 74, 83, 85, 89, 91.

[19] Reference Nos. 34-37, 43, 49, 63, 67, 73.

[20] Reference Nos. 12-13, 47, 81.

[21] Reference Nos. 30-31, 33, 35-36, 39, 43, 50, 63, 71-73, 76-77, 81, 84, 89, 92, 93, 98, 101, 104, 108, 110-112.

[22] Reference Nos. 11, 16, 20, 23, 31, 37, 43, 52, 72. 109

[23] Reference Nos. 6-10, 19, 25, 38, 41, 44-45, 60-62, 64, 69, 75, 81-82, 87-88, 90, 92, 93, 94, 98, 100, 101, 104, 108, 110-112.

In the Section of the Souw Appendix entitled **"II. Theoretical Part,"** on page 14, Examiner Souw posits the following arguments that are easily rebutted:

> Applicant's response does not remove any of the Examiner's refutations of his Grand Unified Theory of Quantum Mechanics, hereinafter GUT, as presented in the original Souw Appendix included in the previous office action. Rather, Applicant's response adds a large number of new mathematical and physical errors. Because those new errors are numerous, it is not possible to analyze them one by one without ending up writing hundreds of pages. Therefore, as done with GUT in the previous Appendix, only the significant ones will be addressed in the following sections, which are divided into the same paragraphs or sections as in the previous Appendix.

Applicant shows herein that the Examiner is stuck in his myopic view of quantum weirdness that prevents him from understanding and applying physical laws correctly. In fact, the Examiner is confused as to what constitutes a physical law. The Examiner argues that the postulated mathematics of SQM is a physical law. The reality is that SQM is incompatible with the physical laws of Maxwell, Newton, and special and general relativity, which is well known. The Examiner's failure to grasp this basic concept exposes yet another fatal flaw in his analysis.

Applicant has now solved hundreds of atomic problems such as ionization energies of multi-electron atoms, excited states, spectral fine structure and hyperfine structure, bonding parameters, ratios of the masses of fundamental, particles, the nature of the chemical bond and fundamental particles, and more. These results are in stunning agreement with the data. Applicant has also had his theory reviewed by outside experts, all Ph.D.'s with high credentials. These experts agree with Applicant that physical laws do apply on the atomic scale after all in contrast to the long-held views of quantum weirdness according to SQM.

Review by Dr. Jonathan Phillips

Review of "The Grand Unified Theory of Classical Quantum Mechanics" by Randell L. Mills

Jonathan Phillips, University of New Mexico Nat'l Lab Professor, Farris Engineering Center, Albuquerque, NM 87131

A dispassionate analysis of modifications in physics theory over the last decade indicates a new paradigm is needed. Theory now requires neutrinos to both have mass and travel at the speed of light, indicates that greater than 90% of the universe is "dark matter" or "dark energy" of unspecified form and origin, and is in search of a vast modification to virtual particle theory to explain the missing "quantum foam." An older and still valid reason to look for a new paradigm: There is still no explanation for the postulated failure of Maxwell's equations "at the order of *h*." Even given the advantage of that postulate, QED cannot provide explanations of simple features of atoms such as the origin of electron spin, a reasonable derivation of the g-factor, or provide precise values of almost any of the features of multi-electron atoms, such as the energies of excited states. Using only Maxwell's equations and Newton's Laws, while explicitly ignoring Schrödinger's Equation, Dr. Mills has developed a revolutionary "new" quantum physics (Classical Quantum Mechanics, CQM), that to date has passed all experimental tests, and thus must be regarded as a valid scientific model. That is, without resort to a single adjustable parameter and employing only well known constants and standard laws of physics it provides precise quantitative agreement with one set of measured quantities after another. Not only does CQM yield quantitative agreement with data sets that overwhelm the current quantum paradigm, the solutions in most cases are simple, closed form algebraic solutions. If Occam's razor is our guide, Mills CQM is clearly the superior theory.

This reviewer finds the bound electron model to be compelling and complete, particularly because of the remarkable agreement with a wide range of data. The detailed and precise physical model of the bound electron, illustrated with excellent visual aids in the new edition, stands in sharp contrast to the hazy probability cloud of the QED paradigm. In the CQM model bound electrons are spherically symmetric shells of charge, with surface currents, that surround the atomic nucleus at quantized stable radii, the values of which can be determined using Maxwell's and Newton's Laws. In addition, the postulated current pattern of these physical electrons is shown to yield, simply using classical physics, the correct electron spin, and angular momentum. Moreover, the CQM model of the bound electron can solve, with computations performed easily using a spreadsheet, problems that have resisted the most intense applications of the conventional paradigm. Specifically, the CQM approach leads, for the first time, to closed form algebraic solutions that precisely describe the behavior of multi-electron atoms. For example, classical physics indicates that in order for the outer electron in a helium atom to be in a stable orbit it must see a central force equal to that required by Newton's Laws to keep an object in orbit. Those central forces for the outer electron in a helium atom will be a sum of the net electrostatic force of the enclosed electron and the enclosed protons, plus the magnetic interaction of the outer electron and inner electron. Thus, as Dr. Mills shows, classical physics leads to a simple force balance, which reduces to a cubic equation. This equation yields a single real solution for the radius. This radius is then used in the most elementary mechanics equations to yield the energy of each of the excited states. All excited states energies (more than 100), are readily *predicted* using as input to the final closed form equations only the "quantum numbers" of the states in question. For over 100 measured excited states of atomic helium the r^2 value is 0.999994, and the typical relative difference (measured-

predicted/measured) is about 5 significant figures, which is within the error of the experimental data. There are no "fudge factors" such as "zero point energy" in the equations, and the values for the constants are all taken from the NIST web pages. Moreover, the known scattering behavior of helium is in precise agreement with a sphere of the radius predicted by CQM. In contrast, in recent years the standard paradigm methods used to obtained these helium excited state energy values are not based in Schrödinger's equation, but rather complex (e.g., never closed form) derivative forms that invariably require the embrace of non-quantum concepts such as the existence of 'nodes' at which the 'functions' (not wave states) become "infinite." Also, probably due to both the computational resource investment required as well as the inaccuracy of the methods, no more than a handful of excited state energies are ever reported, and there is no basis given for assigning any of those values to particular excited states. The book details many other examples of success using the same CQM force balance approach. Applied to muonium, positronium, and hundreds of ionization energies this elegant, yet mathematically and physically simple, approach produces values in such close agreement with experiment that the results can only be described as stunning. In contrast, the many derivative QED approaches to these problems can best be described as torturous, inaccurate, and incomplete.

The scientific method compels Mills not merely to compare computations based on CQM theory with thoroughly vetted data sets, but to press forward with experimental tests of some of the more surprising predictions of the theory. Many of these are perfect for scientific tests as CQM predicts physical behavior completely at odds with that expected on the basis of conventional theory. Most extraordinary is the prediction that hydrogen can have hitherto undetected stable states in which the electron is at far lower energy levels, and hence the atom is physically smaller, than hydrogen in the almost universally accepted ground state. It is also predicted that transitions to these states will occur in specific mixed gas plasmas, including H_2/Ar, H_2/He and water. As outlined in the text, initial tests using EUV spectroscopy show the existence of spectral lines in precise agreement with this prediction of CQM. There is no conventional physics explanation for the presence of these lines in these mixed gas plasmas. The same is true of NMR spectra from products collected downstream from these plasmas, and careful calorimetry of the plasmas themselves. The calorimetry work shows as much as 30 W of excess energy from plasmas only a few centimeters in volume.

The implications of this new physics are unprecedented. Philosophically, we will move from a physical world which is at best stochastic, perhaps "uncertain," at the core, to a world of simple, immutable physical laws. Engineers will be challenged with the goal of tapping a new and apparently inexhaustible source of energy. Indeed, the new model makes it clear that potentially water can be "burned" to produce enormous energy (i.e. thousands of electron volts per hydrogen atoms) and a byproduct of inert hydrinos ("small hydrogen"), which Mills postulates are the missing dark matter of the universe. Given the success of the theory, which uses only classical physics, in producing simple closed formed solutions to observations that resisted decades of computational effort to match them using the standard paradigm, the success of initial experimental tests of the model, as well as the revolutionary scientific and social implications of this theory, it is clear that the scientific community has an obligation to

calmly and dispassionately test it.

Review by Dr. Shelby T. Brewer

Shelby T. Brewer is President of S. Brewer Enterprises, Inc. He was Chairman, President and CEO of ABB Combustion Engineering Nuclear Power Businesses from 1985 through 1995, accomplishing a major turnaround in this company, and positioning it as the world leader among nuclear suppliers. From 1981 through 1984, he was the top nuclear official in the Reagan Administration, as Assistant Secretary of Energy.

I grew up and was educated (1960s) in a time when Einstein's lifelong (but unattained) quest for a unified field theory was celebrated rather anecdotally, as a sort of historical curiosity. One spoke of theories as 'tools' or 'models'. The prevailing mentality was 'one model does not fit all.' A model would work and be useful in one set of circumstances, but not another; use a model to get practical results, but a pursuit of absolute unifying truth was regarded largely as a waste of candle wax.

Other characteristics of this time in science were intolerance, arrogance, and rigidity. Scientists preened and postured, became intensely political, and delegated the 'doing' of science to students. Science was becoming big science—a big governmental and corporate enterprise—demanding more resources and becoming less accountable. We now have an expensive standing army in American science, marching in place, with little creative, definable mission. Most of what passes for science is merely chauvinism—who has the largest accelerator, etc.

Now along comes Randell Mills. Without expending billions or even millions or even hundreds of thousands of US taxpayers' dollars, Dr. Mills has apparently completed Einstein's quest for a unified field theory. Dr. Mills' theory is presented in his book, *The Grand Unified Theory of Classical Quantum Mechanics* (July 2002). This is a huge achievement for three reasons. First, the Mills Theory tidies up theoretical physics by stitching together quantum mechanics and relativity. That in itself is a major triumph. Second, and more important, the Mills Theory explains several major empirical anomalies that have vexed physicists for decades: the sun's energy balance deficit; the dark matter in space phenomena; and mountains of atomic-electron spectral data that is inconsistent with prevailing theory. Third, the Mills Theory gives rise to the possibility of an inexhaustible energy source based on phenomenology not yet recognized and accepted by the scientific community.

Remarkably, Dr. Mills has developed his theory and its energy generation application as an entrepreneur—without largesse from the US Government, and without the benediction of the US scientific priesthood. Because his enterprise does not suffer these two impediments, it just might succeed. If so, Mills will be the next Thomas Edison.

Shelby T. Brewer
Former Assistant Secretary of Energy
(Top Nuclear Official in the Reagan Administration)

Review by Dr. Günther Landvogt

Dr. Günther Landvogt, "The Grand Unified Theory of Classical Quantum Mechanics", International Journal of Hydrogen Energy, Vol. 28, No. 10, (2003), p. 1155.

In "The Grand Unified Theory of Classical Quantum Mechanics", Dr. Randell L. Mills really presents what the title promises: a theory which unifies Maxwell's equations, Newton's laws, and special and general relativity, electro-dynamics, mechanics, and gravity unified in a consistent theory, reaching from subatomic particles to cosmological dimensions. Only two ideas are basically new: (1) An unconventional, but logical use of Maxwell's equations resulting in a revolutionary interpretation of the electron; (2) A slight modification of general relativity resulting in a revolutionary model of the Universe. The rest of his theory is remarkably old: Mills believes—and verifies—that all the "classical" laws being valid in the "classical" branches of physics also hold in the atomic and subatomic fields. He presents a "classical" quantum mechanics that is simple, transparent, straightforward, consistent, and powerful. It does not need any postulates; the classical laws (including Einstein's) and physical constants are sufficient. Mills' quantum physics makes extensive use of Planck's constant, but avoids too much uncertainty. It is based on Maxwell's wave equation rather than Schrödinger's. The rich harvest is a heavy book filled with a firework of theoretical and practical consequences. Mills' ingenious way of thinking creates in different physical areas astonishing results with fascinating mathematical simplicity and harmony. And his theory is strongly supported by the fact that nearly all these results are in comfortable accordance with experimental findings, sometimes with breathtaking accuracy. Mills predicts fractional quantum energy levels of hydrogen and offers the quasi-chemical process to realize them. His experiments demonstrate that it represents the potential of a highly promising energy source. This is only one example of practical outcome. The book offers far more and is a treasure for scientists and engineers who feel that they have a future. And Mills is still busy at work.

Dr. Günther Landvogt
Stubbenweg 32
22393 Hamburg
Germany
E-mail: g.landvogt@t-online.de
+40 601 41 61

Review by Dr. John J. Farrell

Dr. John J. Farrell

Professor of Chemistry, Emeritus

Franklin & Marshall College

February 10, 2004

The grand unified theory of classical quantum mechanics proposed by Randell L. Mills is breathtaking and powerful. Mills has successfully unified electrodynamics and gravity by applying Maxwell's equations, Newton's laws, and Einstein's special and general relativity with his exceptionally creative and quantitative mind.

Mills begins his theory by developing an entirely new description of the electron in the hydrogen atom (using Maxwell's equations). Unlike standard quantum mechanics, which describes the electron as a point particle, Mills finds that the electron is an infinite number great circles that comprise the surface of a sphere at the Bohr radius. The sum of the masses of all of the great circles is equal to the mass of one electron. Similarly, the sum of charges of all of the great circles is equal to the charge of one electron. After solving for the energy, the angular velocity and the radius of the electron (great circles), Mills derives the correct value for the angular momentum of the electron, h/2(. This is astonishing because theoreticians gave up on associating any systematic motion of the electron with its known angular momentum decades ago hence, the term intrinsic spin angular momentum. Amazingly, Mills goes on to derive, using the same motion of the electron but now considering its charge, the correct magnetic field and value of the magnetic moment of the electron. The chances of deriving the correct values for both the angular momentum and the magnetic moment of the electron without the correct motion of the electron is, quite frankly, zero. Mills must have the correct motion of the electron in the hydrogen atom. Armed with this knowledge, he then derives the values of all of the known physical parameters of the hydrogen atom.

The fun does not stop there. Mills goes on to derive hundreds of physical parameters, such as the masses of leptons, quarks, and gluons. He makes predictions for many aspects of nature for which we do not have known values and for which the predicted values are unanticipated: the acceleration of the expansion of the cosmos; the existence of old galaxies at the beginning of the current cosmological expansion; the maximum and minimum radii of the universe and how long it takes to complete one cycle about 1,000 billion years to go from minimum to maximum and back to minimum again. He not only predicts fractional quantum states for the hydrogen atom (n = 1/2, 1/3, 1/4, Ö), he has identified the extreme ultraviolet spectral lines that result from their formation in hydrogen/helium plasmas.

Mills' grand unified theory of classical quantum mechanics explains the answers to some very old scientific questions, such as what happens to a photon upon absorption and some very modern ones, such as what is dark matter. His theory explains why the Sun's corona is so hot (>1,000,000 K) in spite of the fact that Sun's surface is so cool (6,000 K). Astounding.

What does all of this mean to the average person? A lot. The technology that ensues from Mills' theory will change almost every facet of life for everyone on the planet. The most immediate change will be in how we produce and use energy. The obtainable energies from the catalytic formation of fractional quantum states of hydrogen are intermediate between normal chemical energies and nuclear energies. The advantage here is that the fuel is abundant, non-polluting hydrogen. Scientists, engineers, and economists have touted the hydrogen economy for several decades. Little did they know that it would take the form of catalytically converting hydrogen to lower energy states of hydrogen! Truly, reality is stranger than fiction. The possibilities of this one aspect, energy production, boggle the mind. Furthermore, lower energy hydrogen will double (quadruple?) known chemistry. These smaller-than-normal hydrogen atoms should form chemical bonds that are two to ten times stronger than any known chemical bond. Imagine the strong fibers, the hard surfaces, the materials that will last for decades or centuries without corrosion, the extremely high-voltage batteries that will be possible all made with the light element hydrogen. Have I mentioned the implications of correctly understanding gravity?

Lastly, Mills has made an extremely important contribution to the philosophy of science. He has reestablished cause and effect as the basic principle of science. Probability and chance will still rule at Las Vegas and Atlantic City, but not in the laboratory. Einstein would be pleased.

Multiple theory papers are also accepted for publication in peer-reviewed journals.

Section 55

Examiner Souw continues his error-prone analysis with the following statements appearing on page 14 of his Appendix:

1. **Regarding the derivation of hydrino's fractional energy levels, E_n**

(a) Applicant's arguments regarding GUT, Ch. 1-2, 5-6, as recited in his response on pg.37 are unpersuasive: Applicant's formula for E_n is not derived, but postulated, just as stated by the Examiner so far. First-principle means, the principal formula must come out of mathematical derivation. Thus, applicant's formula is not from first principles. It is to be known, that postulate is acceptable in science (e.g., QM), insofar it is supported by experimental evidence and does not contradict with known natural laws. This is not the case with the hydrino. Its existence is not supported by experimental evidence and is also in violation of quantum mechanics (QM), electrodynamics, and the relativity theory.

The hydrino states are derived from Maxwell's equations and other first principle laws in GUT, Ch. 1-2, 5-6. This can be confirmed by the comparing the match between predictions and experiment observations of conjugate observables using the same solution of the one electron atom as used to derive the hydrino states.

Some of the many confirmatory results are:

STERN-GERLACH EXPERIMENT

The Stern-Gerlach experiment implies a magnetic moment of one Bohr magneton and an associated angular momentum quantum number of 1/2. Historically, this quantum number is called the spin quantum number, s ($s=\frac{1}{2}$; $m_s=\pm\frac{1}{2}$). The superposition of the vector projection of the orbitsphere angular momentum on the z-axis is $\frac{\hbar}{2}$ with an orthogonal component of $\frac{\hbar}{4}$. Excitation of a resonant Larmor precession gives rise to $\hbar$ on an axis $\mathbf{S}$ that precesses about the z-axis called the spin axis at the Larmor frequency at an angle of $\theta=\frac{\pi}{3}$ to give a perpendicular projection of

$$\mathbf{S}_\perp=\pm\sqrt{\frac{3}{4}}\hbar \tag{1}$$

and a projection onto the axis of the applied magnetic field of

$$\mathbf{S}_\parallel=\pm\frac{\hbar}{2} \tag{2}$$

The superposition of the $\frac{\hbar}{2}$, z-axis component of the orbitsphere angular momentum and the $\frac{\hbar}{2}$, z-axis component of $\mathbf{S}$ gives $\hbar$ corresponding to the observed electron magnetic moment of a Bohr magneton, μ_B.

ELECTRON g FACTOR

Conservation of angular momentum of the orbitsphere permits a discrete change of its "kinetic angular momentum" $(\mathbf{r}\times m\mathbf{v})$ by the applied magnetic field of $\frac{\hbar}{2}$, and concomitantly the "potential angular momentum" $(\mathbf{r}\times e\mathbf{A})$ must change by $-\frac{\hbar}{2}$.

$$\Delta\mathbf{L} = \frac{\hbar}{2} - \mathbf{r}\times e\mathbf{A} \tag{3}$$

$$= \left[\frac{\hbar}{2} - \frac{e\phi}{2\pi}\right]\hat{z} \tag{4}$$

In order that the change of angular momentum, $\Delta\mathbf{L}$, equals zero, ϕ must be $\Phi_0 = \frac{h}{2e}$, the magnetic flux quantum. The magnetic moment of the electron is parallel or antiparallel to the applied field only. During the spin-flip transition, power must be conserved. Power flow is governed by the Poynting power theorem,

$$\nabla\bullet(\mathbf{E}\times\mathbf{H}) = -\frac{\partial}{\partial t}\left[\frac{1}{2}\mu_o\mathbf{H}\bullet\mathbf{H}\right] - \frac{\partial}{\partial t}\left[\frac{1}{2}\varepsilon_o\mathbf{E}\bullet\mathbf{E}\right] - \mathbf{J}\bullet\mathbf{E} \tag{5}$$

Eq. (6) gives the total energy of the flip transition which is the sum of the energy of reorientation of the magnetic moment (1st term), the magnetic energy (2nd term), the electric energy (3rd term), and the dissipated energy of a fluxon treading the orbitsphere (4th term), respectively,

$$\Delta E_{mag}^{spin} = 2\left(1 + \frac{\alpha}{2\pi} + \frac{2}{3}\alpha^2\left(\frac{\alpha}{2\pi}\right) - \frac{4}{3}\left(\frac{\alpha}{2\pi}\right)^2\right)\mu_B B \tag{6}$$

$$\Delta E_{mag}^{spin} = g\mu_B B \tag{7}$$

where the stored magnetic energy corresponding to the $\frac{\partial}{\partial t}\left[\frac{1}{2}\mu_o\mathbf{H}\bullet\mathbf{H}\right]$ term increases, the stored electric energy corresponding to the $\frac{\partial}{\partial t}\left[\frac{1}{2}\varepsilon_o\mathbf{E}\bullet\mathbf{E}\right]$ term increases, and the $\mathbf{J}\bullet\mathbf{E}$ term is dissipative. The spin-flip transition can be considered as involving a magnetic moment of g times that of a Bohr magneton. The g factor is redesignated the fluxon g factor as opposed to the anomalous g factor. Using $\alpha^{-1} = 137.03603(82)$,

the calculated value of $\frac{g}{2}$ is $\mathbf{1.001\ 159\ 652\ 137}$. The experimental value [1] of $\frac{g}{2}$ is $\mathbf{1.001\ 159\ 652\ 188(4)}$.

References

1. R. S. Van Dyck, Jr., P. Schwinberg, H. Dehmelt, "New high precision comparison of electron and positron g factors", Phys. Rev. Lett., Vol. 59, (1987), p. 26-29.

Lamb Shift

The Lamb Shift of the $^2P_{1/2}$ state of the hydrogen atom is due to conservation of energy and linear momentum of the emitted photon, electron, and atom.

Electron Component

$$\Delta f = \frac{\Delta\omega}{2\pi} = \frac{E_{h\upsilon}}{h} = \frac{(E_{h\upsilon})^2}{2h\mu_e c^2} = 1052.48\ MHz$$

where $E_{h\upsilon}$ is

$$E_{h\nu} = 13.5983\ eV\left(1-\frac{1}{n^2}\right)\frac{3}{4\pi}\sqrt{\frac{3}{4}} - h\Delta f$$

$$h\Delta f <<< 10\ eV; \quad n = 2$$

$$\therefore E_{h\nu} = 13.5983\ eV\left(1-\frac{1}{2^2}\right)\frac{3}{4\pi}\sqrt{\frac{3}{4}}$$

Atom Component

$$\Delta f = \frac{\Delta\omega}{2\pi} = \frac{E_{h\upsilon}}{h} = \frac{(E_{h\upsilon})^2}{2hm_H c^2} = \frac{\left(13.5983\ eV\left(1-\frac{1}{2^2}\right)\left(1+\frac{1}{2}-\sqrt{\frac{3}{4}}\right)\right)^2}{2hm_H c^2} = 5.3839\ MHz$$

Sum of Components

$$\Delta f = 1052.48\ MHz + 5.3839\ MHz = 1057.87\ MHz$$

The experimental Lamb Shift is $\Delta f = 1057.862\ MHz$

The other core results of SQM can be replicated using closed form equations containing fundamental constants only without involving renormalization and virtual particles. The results derived from Maxwell's equations are in remarkable agreement between the calculated and experimental values that are only limited by the accuracy of the fundamental constants.

FINE STRUCTURE

The fine structure energy is the Lamb-shifted relativistic interaction energy between the spin and orbital magnetic moments due to the corresponding angular momenta.

The energy, E_{FS} and frequency, Δf_{FS}, for the ${}^2P_{3/2} \rightarrow {}^2P_{1/2}$ transition called the fine structure splitting is given by the sum:

$$E_{FS} = \frac{\alpha^5 (2\pi)^2}{8} m_e c^2 \sqrt{\frac{3}{4}} + \left(13.5983\ eV\left(1 - \frac{1}{2^2}\right)\right)^2 \left[\frac{\left(\frac{3}{4\pi}\left(1 - \sqrt{\frac{3}{4}}\right)\right)^2}{2h\mu_e c^2} + \frac{\left(1 + \left(1 - \sqrt{\frac{3}{4}}\right)\right)^2}{2hm_H c^2}\right]$$

$$= 4.5190\, X\, 10^{-5}\ eV + 1.75407\, X\, 10^{-7}\ eV$$
$$= 4.53659\, X\, 10^{-5}\ eV$$

$$\Delta f_{FS} = 10{,}927.0\ MHz + 42.4132\ MHz = 10{,}969.4\ MHz$$

The energy of $4.53659\ X\, 10^{-5}\ eV$ corresponds to a frequency of $10{,}969.4\ MHz$, or a wavelength of $2.73298\ cm$.

The experimental value of the ${}^2P_{3/2} — {}^2P_{1/2}$ transition frequency is $10{,}969.1\ MHz$.

HYPERFINE STRUCTURE

The hyperfine structure of the hydrogen atom is calculated from the force balance contribution between the electron and the proton.

The energy corresponds to the Stern-Gerlach and stored electric and magnetic energy changes.

The total energy of the transition from antiparallel to parallel alignment, $\Delta E_{total}^{S/N}$, is given as the sum:

$$\begin{aligned}\Delta E_{total}^{S/N} &= -\mu_0 \mu_B \mu_P \sqrt{\frac{3}{4}}\left(\frac{1}{r_+^3}+\frac{1}{r_-^3}\right)+\frac{-e^2}{8\pi\varepsilon_o}\left[\frac{1}{r_+}-\frac{1}{r_-}\right]+\left(-1-\left(\frac{2}{3}\right)^2-\frac{\alpha}{4}\right)4\pi\mu_o\mu_B^2\left(\frac{1}{r_+^3}-\frac{1}{r_-^3}\right)\\ &= -1.918365\,X\,10^{-24}\,J+9.597048\,X\,10^{-25}\,J+1.748861\,X\,10^{-26}\,J\\ &= -9.411714\,X\,10^{-25}\,J\end{aligned}$$

where

$$r = a_H \pm \frac{2\pi\alpha\,\mu_P}{ec}\sqrt{\frac{3}{4}}$$

The energy is expressed in terms of wavelength using the Planck relationship:

$$\lambda = \frac{hc}{\Delta E_{total}^{S/N}} = 21.10610\ cm$$

The experimental value from the hydrogen maser is $21.10611\ cm$.

MUONIUM HYPERFINE STRUCTURE INTERVAL

The hyperfine structure of muonium is calculated from the force balance contribution between the electron and muon.

The energy corresponds to the Stern-Gerlach and stored electric and magnetic energy changes.

The energy of the ground state $(1^2S_{1/2})$ hyperfine structure interval of muonium, $\Delta E(\Delta \nu_{Mu})$, is given by the sum:

$$\Delta E(\Delta \nu_{Mu}) = -\mu_0 \mu_B \mu_\mu \sqrt{\frac{3}{4}}\left(\frac{1}{r_{2+}^3} + \frac{1}{r_{2-}^3}\right) + \frac{-e^2}{8\pi\varepsilon_o}\left[\frac{1}{r_{2+}} - \frac{1}{r_{2-}}\right]$$
$$+ 4\pi\mu_o\left(-1-\left(\frac{2}{3}\cos\frac{\pi}{3}\right)^2 - \alpha\right)\left(\mu_B^2\left(\frac{1}{r_{2+}^3} - \frac{1}{r_{2-}^3}\right) + \mu_{B,\mu}^2\left(\frac{1}{r_{1+}^3} - \frac{1}{r_{1-}^3}\right)\right)$$
$$= -6.02890320\ X\,10^{-24}\ J + 3.02903048\ X\,10^{-24}\ J + 4.23209178\ X10^{-26}\ J + 1.36122030\ X\,10^{-28}\ J$$
$$= -2.95741568\ X\,10^{-24}\ J$$

where

$$r_2 = a_\mu \pm \frac{2\pi\alpha\,\mu_\mu}{ec}\sqrt{\frac{3}{4}}$$

and

$$r_1 = \frac{a_\mu \pm \frac{2\pi\alpha\,\mu_\mu}{ec}\sqrt{\frac{3}{4}}}{\left(\frac{m_\mu}{m_e} \pm \frac{m_\mu e\alpha c}{2\hbar^2}\mu_0\,\mu_\mu\sqrt{\frac{3}{4}}\right)^{1/3}}$$

Using Planck's equation, the interval frequency, $\Delta\nu_{Mu}$, and wavelength, $\Delta\lambda_{Mu}$, are

$$\Delta\nu_{Mu} = 4.46330328\ GHz$$
$$\Delta\lambda_{Mu} = 6.71682919\ \text{cm}$$

The experimental hyperfine structure interval of muonium is

$$\Delta E(\Delta v_{Mu}) = -2.957415336\ X\,10^{-24}\ J$$
$$\Delta v_{Mu} = 4.463302765(53)\ GHz\ (12\,ppm)$$
$$\Delta \lambda_{Mu} = 6.71682998\ \text{cm}$$

POSITRONIUM HYPERFINE STRUCTURE

The leptons are at the same radius, and the positronium hyperfine interval is given by the sum of the Stern-Gerlach, $\Delta E_{\text{spin-spin}}$, and fine structure, $\Delta E_{s/o}({}^3S_1 \rightarrow {}^1S_0)$, energies.

The hyperfine structure interval of positronium (${}^3S_1 \rightarrow {}^1S_0$) is given by the sum:

$$\begin{aligned}
\Delta E_{\text{Ps hyperfine}} &= \Delta E_{\text{spin -spin}} + \Delta E_{s/o}({}^3S_1 \rightarrow {}^1S_0) \\
&= \frac{g\mu_o e^2 \hbar^2}{8m_e^2 (2a_0)^3} + \frac{3g\alpha^5 (2\pi)^2}{8} m_e c^2 \sqrt{\frac{3}{4}} \\
&= \frac{g\alpha^5 (2\pi)^2}{8} m_e c^2 \left(\frac{1}{8\pi\alpha} + \frac{3\sqrt{3}}{2} \right) \\
&= 8.41155110\ X\,10^{-4}\ eV
\end{aligned}$$

Using Planck's equation, the interval in frequency, $\Delta\upsilon$, is

$$\Delta\upsilon = 203.39041\ GHz$$

The experimental ground-state hyperfine structure interval is

$$\Delta E_{\text{Ps hyperfine}}(\text{experimental}) = 8.41143\ X\,10^{-4}\ eV$$
$$\Delta\upsilon(\text{experimental}) = 203.38910(74)\ GHz\ (3.6\,ppm)$$

The relativistic one-electron atom ionization energies in closed-form equations with fundamental constants are given by

$$\gamma^{*} = \frac{2\pi}{2\pi\sqrt{1-\left(\frac{v}{c}\right)^{2}}\sin\left[\frac{\pi}{2}\left(1-\left(\frac{v}{c}\right)^{2}\right)^{3/2}\right]+\cos\left[\frac{\pi}{2}\left(1-\left(\frac{v}{c}\right)^{2}\right)^{3/2}\right]} \tag{1.250}$$

$$E_{ele} = -\gamma^{*}\frac{Z^{2}e^{2}}{8\pi\varepsilon_{o}a_{0}}\frac{\mu}{m_{e}} = -\gamma^{*}\frac{\mu}{m_{e}}Z^{2}\,X\,2.1799\,X\,10^{-18}\,J = -\gamma^{*}\frac{\mu}{m_{e}}Z^{2}\,X\,13.606\,eV \tag{1.251}$$

Table 1.5. Relativistically corrected ionization energies for some one-electron atoms.

One e Atom	Z	γ^* a	Theoretical Ionization Energies (eV) b	Experimental Ionization Energies (eV) c	Relative Difference between Experimental and Calculated d
H	1	1.000007	13.59838	13.59844	0.00000
He^{+}	2	1.000027	54.40941	54.41778	0.00015
Li^{2+}	3	1.000061	122.43642	122.45429	0.00015
Be^{3+}	4	1.000109	217.68510	217.71865	0.00015
B^{4+}	5	1.000172	340.16367	340.2258	0.00018
C^{5+}	6	1.000251	489.88324	489.99334	0.00022
N^{6+}	7	1.000347	666.85813	667.046	0.00028
O^{7+}	8	1.000461	871.10635	871.4101	0.00035
F^{8+}	9	1.000595	1102.65013	1103.1176	0.00042
Ne^{9+}	10	1.000751	1361.51654	1362.1995	0.00050
Na^{10+}	11	1.000930	1647.73821	1648.702	0.00058
Mg^{11+}	12	1.001135	1961.35405	1962.665	0.00067
Al^{12+}	13	1.001368	2302.41017	2304.141	0.00075
Si^{13+}	14	1.001631	2670.96078	2673.182	0.00083
P^{14+}	15	1.001927	3067.06918	3069.842	0.00090
S^{15+}	16	1.002260	3490.80890	3494.1892	0.00097
Cl^{16+}	17	1.002631	3942.26481	3946.296	0.00102
Ar^{17+}	18	1.003045	4421.53438	4426.2296	0.00106
K^{18+}	19	1.003505	4928.72898	4934.046	0.00108
Ca^{19+}	20	1.004014	5463.97524	5469.864	0.00108
Sc^{20+}	21	1.004577	6027.41657	6033.712	0.00104
Ti^{21+}	22	1.005197	6619.21462	6625.82	0.00100
V^{22+}	23	1.005879	7239.55091	7246.12	0.00091
Cr^{23+}	24	1.006626	7888.62855	7894.81	0.00078
Mn^{24+}	25	1.007444	8566.67392	8571.94	0.00061
Fe^{25+}	26	1.008338	9273.93857	9277.69	0.00040
Co^{26+}	27	1.009311	10010.70111	10012.12	0.00014
Ni^{27+}	28	1.010370	10777.26918	10775.4	-0.00017
Cu^{28+}	29	1.011520	11573.98161	11567.617	-0.00055

a From theoretical calculations, interpolation of H isoelectronic and Rydberg series, and experimental data [43-44].

b (Experimental-theoretical)/experimental.

43. C. E. Moore, "Ionization Potentials and Ionization Limits Derived from the Analyses of Optical Spectra, Nat. Stand. Ref. Data Ser.-Nat. Bur. Stand. (U.S.), No. 34, 1970.

44. D. R. Lide, *CRC Handbook of Chemistry and Physics*, 79 th Edition, CRC Press, Boca Raton, Florida, (1998-9), p. 10-175 to p. 10-177.

These results can not be matched with SQM, which is not predictive. They also disprove the Examiner's position that the hydrino states are not derived.

Section 56

Examiner Souw further argues on page 15 of his Appendix that:

(b) As already demonstrated in said Appendix, those GUT chapters are full of mathematical flaws and violations of elementary principles of physics, some of which have been previously discussed and will be consequently prosecuted in the following sections.

These results are derived from physical laws and do not contain mathematical errors as confirmed by the remarkable agreement between the calculated and experimental results and as confirmed by independent peer review as discussed in Sections 54-55 above. The Examiner's inability to overcome these stunning results is patently obvious and only further highlights the bias inherent in his faulty analysis.

Section 57

Examiner Souw further states on page 15 of his Appendix:

2. Regarding the alleged "electrostatic Schrödinger Equation (SE)" and "stationary electron"

(a) Applicant has misrepresented the Examiner's previous statements as none of the wording alleged by Applicant, i.e., "electrostatic Schrödinger Equation (SE)" and "stationary electron" is recited by the Examiner in said Appendix. As such, the Examiner is not giving any weight to these arguments thus presented.

Examiner Souw, however, has not provided a basis for the stability of a point electron bound to a proton. It must radiate according to Maxwell's equations. More on the instability of the hydrogen atom according to SQM is given below.

Section 58

Examiner Souw continues with his erroneous analysis on pages 15-16 of his Appendix, arguing that:

> (b) Applicant has misunderstood the fundamental QM concept of "stationary state" (see original Souw Appendix pg. 1/ sect.2/lines I and 3), in which the term "stationary" (or "static") simply means "does not change with time" (as defined in the Appendix pg.2/line 1). This "stationary state" is a fundamental concept that can be found in every QM textbook (see, e.g., McQuarrie [1], Ch.4.3, pg. 121, lines 2-3 from bottom, *"Thus, the probability density and the averages calculated from Eq. 4-19 are independent of time, and the $ø_n(x)$ are called stationary-state wave functions".* As such, the wording "stationary state" would never be misinterpreted as "motionless electron" by any one of ordinary skill in the art. As known in the art, an electron in a stationary state is in motion, wherein the motion, or velocity, is inherent in the wavefunction, and is represented by the eigenvalue (for a single state) or expectation value (for a superposition of states) of the particle momentum operator ***p*** (operators are written in *bold italics)* divided by the mass m (scalar non-operator), i.e., ***V***=***p***/*m*, such that the particle velocity is <***V***> = (1/m)?<ø*,***p***ø>, in which the operator ***p*** is represented by -i_ **grad** in the Schrödinger representation. The "stationary" state or "static" probability density (to be distinguished from Applicant's stationary electron) is a direct consequence of the uncertainty relation (see original Souw Appendix/lines 8-10), since the energy E of the state, and also its angular momentum L, are sharply defined, i.e., äE=O and äL=O, which consequently leads to ät=? (does not change with time) and äö=2∂ (total uncertainty of angular position ö), the latter because the angular momentum operator is defined as ***L***=i_?/?? (or by scalar operator $\boldsymbol{L}^2$), and the complementary of the angular momentum is the angular position p, which is equivalent to the complementarity between ***p*** and ***x***, leading to äx=? for äp=0 in case of linear momentum and position. In simple terms understandable to those ordinarily skilled in the art, an electron plane wave represented by ø~exp(ikx-iùt) also results in a stationary probability (charge) density, p = $|ø|^2$ = constant in time, i.e., static, per definition. However, the electron itself (to be distinguished from its state or probability density) is not stationary or static, but instead, moving with a momentum of p=_k and a kinetic energy of E=$\_^2k^2$/2m. This is a most basic element of QM well known to-those ordinarily skilled in the art. For these reasons, Applicant's "refutation" of the QM are unpersuasive.

These arguments have no merit inasmuch as Examiner Souw presents an impossible situation—that of a moving point electron that is **always** constant in its position/distribution. Furthermore, the Examiner contradicts himself once again by

stating that the average distribution is constant. This is very different from the instantaneous position being constant. It is the inconstancy of the latter that must give rise to radiation.

It is well known that the Bohr model gives a constant average position/distribution of the harmonic motion, but it is also predicted to radiate due to the instantaneous motion that is not constant.

Section 59

On pages 16-17 of his Appendix, Examiner Souw once again erroneously argues that:

> The QM method of calculating spectral line intensities based on vector- and tensoroperators as presented, e.g., by Condon EU. & Shortley G.H., "The Theory of Atomic Spectra", Cambridge 1967, pp. 45-69, and 112-147 [2], has been mathematically implemented and experimentally verified by the Examiner himself in his two previously cited works [3, 4]. The experimental verification involving hundreds of spectral lines as functions of electric/magnetic fields was made without a single error or failure. The results were extremely accurate within less than 10^{-5} nm, which is far more superior to the 0.1 nm accuracy achieved in Applicant's measurements. As a proof for the correctness of conventional QM, similar mathematical verifications have been also demonstrated by a great number of other authors. In this regard, a reference to the Examiner's own work is here to be considered important, so as to exclude the possibility of an invalid dismissal from Applicant's side, such as "the Examiner misunderstands his own reference". As already brought up in the previous Appendix, Applicant's Grand Unified Theory (GUT) wave function is incapable of calculating line splitting and line intensities, including line absorption cross-sections, as the conventional QM is evidently capable of (see [2], [3] and [4]). Applicant is invited to present detailed step-by-step calculations showing how his theory is capable of predicting the line intensities and applicant has not done so to date.

The supposedly accurate results of quantum mechanics for spectral lines are easily explainable—they are due to the remarkable ability to use computers for curve fitting. The Examiner has provided no evidence that any calculation based on SQM is grounded in physical laws. Applicant has now calculated the excited state spectrum of helium in closed-form equations with fundamental constants only. The agreement of the precise values obtained by inserting the quantum number of the state into the

equations is in remarkable agreement with the NIST values for over 100 reported states. The same solutions predict the other conjugate parameters of the helium atom for the first time. These results have not been matched by SQM in the 80 years of its existence.

The abstract is given as follows:

106. **R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Foundation Louis de Broglie, submitted.**

Quantum mechanics (QM) and quantum electrodynamics (QED) are often touted as the most successful theories ever. In this paper, this claim is critically evaluated by a test of internal consistency for the ability to calculate the conjugate observables of the nature of the free electron, ionization energy, elastic electron scattering, and the excited states of the helium atom using the same solution for each of the separate experimental measurements. It is found that in some cases quantum gives good numbers, but the solutions are meaningless numbers since each has no relationship to providing an accurate physical model. Rather, the goal is to mathematically reproduce an experimental or prior theoretical number using adjustable parameters including arbitrary wave functions in computer algorithms with precision that is often much greater (e.g. 8 significant figures greater) than possible based on the propagation of errors in the measured fundamental constants implicit in the physical problem. Given the constraints of adherence to physical laws and internal consistency, an extensive literature search indicates that quantum mechanics has never solved a single physical problem correctly including the hydrogen atom and the next member of the periodic chart, the helium atom. Rather than using postulated unverifiable theories that treat atomic particles as if they were not real, physical laws are now applied to the same problem. In an attempt to provide some physical insight into atomic problems and starting with the same essential physics as Bohr of e^- moving in the Coulombic field of the proton and the wave equation as modified after Schrödinger, a classical approach is explored which yields a model which is remarkably accurate and provides insight into physics on the atomic level. The proverbial view deeply seated in the wave-particle duality notion that there is no large-scale physical counterpart to the nature of the electron is shown not to be correct. Physical laws and intuition may be restored when dealing with the wave equation and quantum atomic problems. Specifically, a theory of classical quantum mechanics (CQM) was derived from first principles as reported previously

[1-6] that successfully applies physical laws to the solution of atomic problems that has its basis in a breakthrough in the understanding of the stability of the bound electron to radiation. Rather than using the postulated Schrödinger boundary condition: "$\Psi \rightarrow 0$ as $r \rightarrow \infty$", which leads to a purely mathematical model of the electron, the constraint is based on experimental observation. Using Maxwell's equations, *the classical wave equation is solved with the constraint that the bound $n = 1$-state electron cannot radiate energy.* Although it is well known that an accelerated *point* particle radiates, an *extended distribution* modeled as a superposition of accelerating charges does not have to radiate. A simple invariant physical model arises naturally wherein the predicted results are extremely straightforward and internally consistent requiring minimal math as in the case of the most famous equations of Newton, Maxwell, Einstein, de Broglie, and Planck on which the model is based. No new physics is needed; only the known physical laws based on direct observation are used. The accurate solution of the helium atom is confirmed by the agreement of predicted and observed conjugate parameters using the same unique physical model in all cases.

Applicant has also correctly calculated the energy levels for over 100 Stark split states of hydrogen, derived correctly the selection rules and derived the equation for line intensities in Ref. #1 (GUT Chp. 2), a truly remarkable accomplishment.

What is not so remarkable is that the Examiner can not see past his own biases to allow himself to even consider Applicant's evidence objectively.

Section 60

The inconsistencies that predominate Examiner Souw's analysis can also be found on pages 17-18 of the Appendix, which states:

(c) Regarding pg.40 of the amendment, the Examiner's argument has been (and is),that not only the ground state, but all stationary states must be also non-radiative in consequence of the Haus theorem, since their probability density distribution does not change with time (i.e., per definition, stationary; see previous Appendix section 2, lines 1-2). To "see" an electron physically moving around an atom, a wave packet has to be constructed as a superposition of stationary states having not only a plurality of orbital quantum numbers (L,m), as described in the original Souw Appendix, sect.2, but also involving at least two principal quantum numbers, n_1 and n_2, as discussed in the original Appendix sect.3. Only then, can a non-vanishing time dependence of the probability density be established, i.e., by virtue of the cross-term p = $|ø|^2$~exp i($ù_1$¯$ù_2$)·t (Note: the energy of a free hydrogen atom, and hence, its frequency, $ù_n$=E_n/_, only depends on the principal quantum number

n). This corresponds to the transition probability discussed in sect.3 of the original Appendix, which also agrees with the Haus's condition, that a free hydrogen atom composed of at least two eigenstates of different principal quantum numbers does radiate, i.e., making a transition from n_2-state to n_1-state.

Here again, Examiner Souw makes an internally inconsistent argument in claiming that "not only the ground state, but all stationary states must be also non-radiate in consequence of the Haus theorem". Then he states that " a free hydrogen atom composed of at least two eigenstates of different principal quantum numbers does radiate, i.e., making a transition from n_2-state to n_1-state". Such inconsistencies only add to the fatal flaws plaguing the Examiner's erroneous analysis.

Section 61

Examiner Souw further argues on page 18 of his Appendix that:

> This conclusion regarding stationary states is a direct consequence of the Heisenberg Uncertainty Principle, and has been made by the Examiner independent from --but in agreement with-- Feynman and other authorities in QM, the latter contended by the Applicant himself (see 2.d.(5) below).

Other authorities, including theoreticians from Princeton University, agree with Applicant that the Feynman argument that the stability of the hydrogen atom is based on the Heisenberg Uncertainty Principle is false.

Under SQM, the electron is not stable to radiation and states of lower energy than the n=1 state are not precluded. This point is shown by Applicant's analysis [80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted] as well as by other theoreticians such as those at Princeton University who show that the Heisenberg Uncertainty Principle provides no atomic stability [E. H. Lieb, "The stability of matter", Reviews of Modern Physics, Vol. 48, No. 4, (1976), pp, 553-569]. The abstract of Ref. #80 is given below:

> Abstract
>
> Recently published data showing that the Rydberg series extends to lower states in a catalytic plasma reaction [R. L. Mills, P. Ray, "Extreme Ultraviolet Spectroscopy of Helium-Hydrogen Plasma", J. Phys. D, Applied

Physics, Vol. 36, (2003), pp. 1535-1542] has implication for the theoretical basis of the stability of the hydrogen atom. The hydrogen atom is the only real problem for which the Schrödinger equation can be solved without approximations; however, it only provides three quantum numbers—not four, and inescapable disagreements between observation and predictions arise from the later postulated Dirac equation as well as the Schrödinger equation. Furthermore, unlike physical laws such as Maxwell's equations, it is always disconcerting to those that study quantum mechanics (QM) that the particle-wave equation and the intrinsic Heisenberg Uncertainty Principle (HUP) must be accepted without any underlying physical basis for fundamental observables such as the stability of the hydrogen atom in the first place. In this instance, a circular argument regarding definitions for parameters in the wave equation solutions and the Rydberg series of spectral lines replaces a first-principles-based prediction of those lines. It is shown that the quantum theories of Bohr, Schrodinger, and Dirac provide no intrinsic stability of the hydrogen atom based on physics. An old argument from Feynman based on the HUP is shown to be internally inconsistent and fatally flawed. This argument and some more recent ones further brings to light the many inconsistencies and shortcomings of QM and the intrinsic HUP that have not been reconciled from the days of their inception. The issue of stability to radiation needs to be resolved, and the solution may eliminate of some of the mysteries and intrinsic problems of QM.

Section 62

On page 18 of the Souw Appendix, the Examiner makes the following astounding statement:

> In contrast, Applicant's theory based on <u>point electron</u>, as recited in GUT and on pg.39 is incorrect, since it is in <u>total</u> contradiction to and <u>not reconcilable</u> with the routine experimental observations of electron wave properties, such as interference effects that have found many useful applications, e.g., Reflection High Energy Electron Diffraction (RHEED) and Low Energy Electron Diffraction (LEED).

It is hard to believe that the Examiner has read anything on CQM. The fundamental premise of CQM is that the electron is <u>not</u> a point such **as it is in SQM**. For special extended distributions, acceleration without radiation is possible. On this basis, the extended charge-density functions are derived from Maxwell's equations. To assist the Examiner in understanding this concept, a picture of the bound and free electron charge (mass)-density functions are given below:

Figure 1.1. The orbitsphere is a two-dimensional spherical shell of zero thickness with the Bohr radius of the hydrogen atom, $r = a_H$. It is nonradiative, a minimum-energy surface, and extremely stable in that the balanced forces correspond to a pressure of twenty million atmospheres.

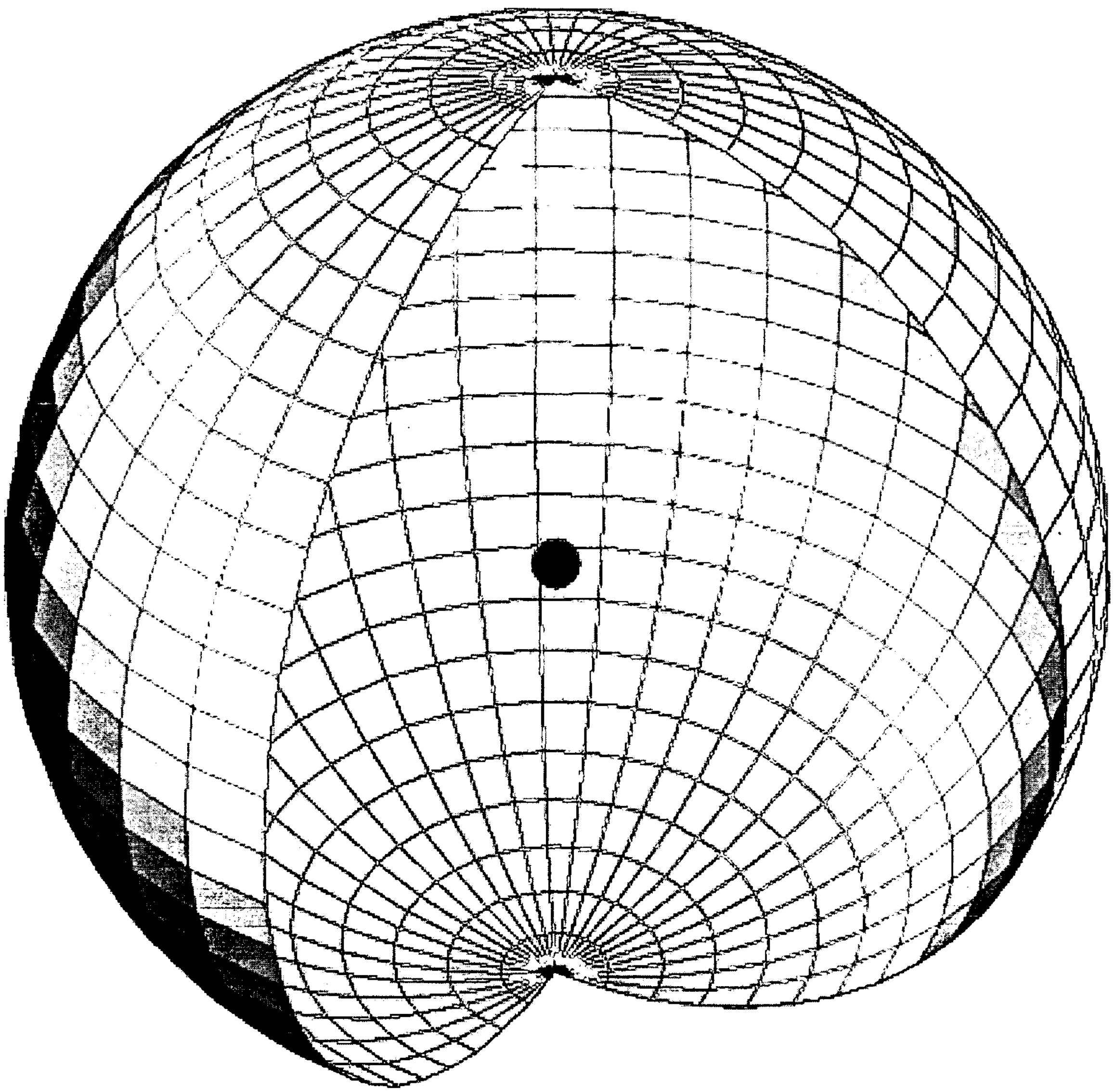
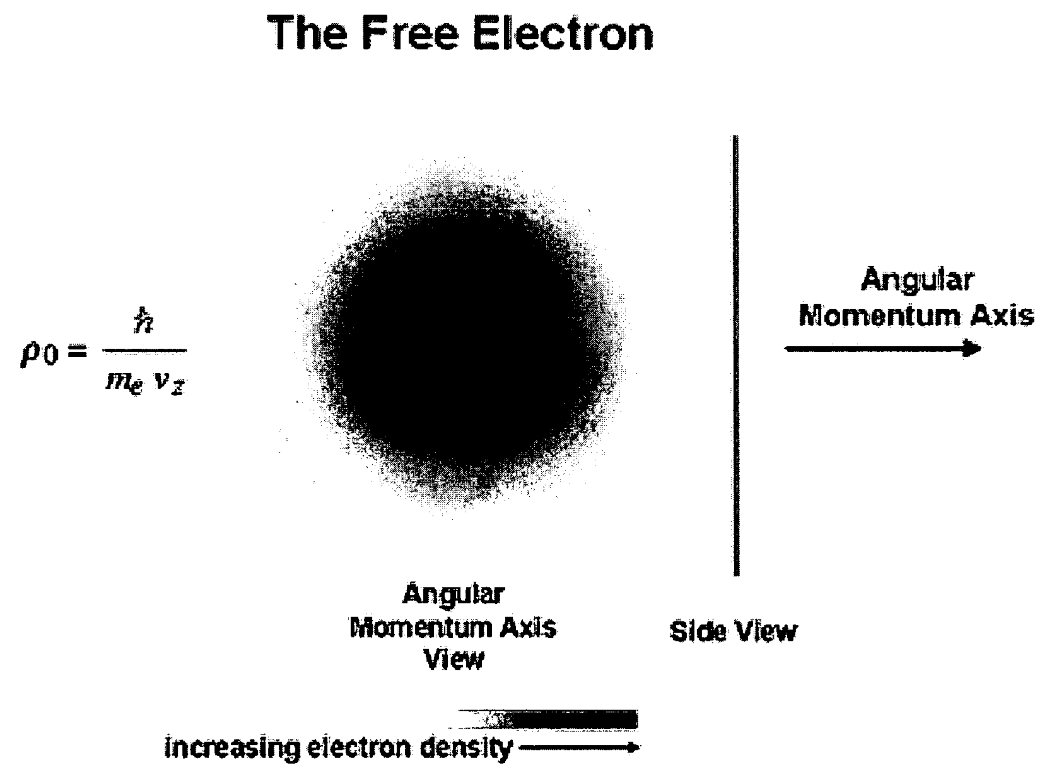


Figure. 3.1A. The angular-momentum-axis view of the magnitude of the continuous mass (charge)-density function in the xy-plane of a polarized free electron propagating along the z-axis and the side view of this electron. For the polarized electron, the angular momentum axis is aligned along the direction of propagation, the z-axis.



Animation and supporting visual aids are given at the following web site: http://www.blacklightpower.com/theory/theory.shtml

Section 63

Examiner Souw further argues on page 18 of his Appendix:

(d) On pg.39, applicant presents new arguments that the Examiner takes issue with as follows:

(1) Applicant's analysis based on Haus theorem is mathematically and physically flawed, as already addressed in the previous Souw Appendix, to be again repeated and emphasized in the following sections (i.e., mathematically, regarding Applicant's "solution" of electron wave function p(r,t) based on the ä-

function that does not satisfy the wave equation; and physically, the non-applicability of Lorentz contraction formula to Applicant's orbiting electron).

The Examiner is stuck in his myopic view according to SQM that the electron must move in the radial direction and be a solution of the three-dimensional wave equation plus time. There is no a priori reason for this to be the case. If fact, it can't be. Since the electron is bound in an inverse-squared central field, any radial motion must result in a change in the angular momentum and the total energy of the electron. Since the total energy is constant (13.6 eV), this can not be the case. The radial Dirac delta function corresponds to the two-dimensional wave equation plus time. This wave equation gives the correct physics of constant energy and angular momentum and provides for the stability of the bound electron to radiation in accordance with Maxwell's equations. See, for example:

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.
106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted.
102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One- Through Twenty-Electron Atoms", Physics Essays, submitted.
94. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", Physics Essays, in press.
80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.
58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.
21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

As given in many instances, such as the Introduction of Mills GUT (Ref. #1):

CQM APPROACH TO THE SOLUTION OF THE ELECTRON

CQM solves the electron by a different approach than that used to solve the Schrödinger wave equation. Rather than using a postulated wave equation with time eliminated in terms of the energy of the electron in a Coulomb field and solving the charge wave (Schrödinger interpretation) or the probability wave (Born interpretation), the solution for the scalar (charge) and vector potential (current) functions of the electron are sought based on first principles. CQM first assumes that the functions that physically describe the mass and charge of the electron in space and time obey the wave equation since it conserves energy and angular momentum. The solution is initially generalized to be three dimensional plus time. Rather than use the postulated Schrödinger boundary condition: "$\Psi \to 0$ as $r \to \infty$", which leads to a purely mathematical model of the electron, the constraint is based on the experimental observation that the moving charge must not radiate. Application of the Haus' condition based on Maxwell's equations to a generalized three dimension plus time wave equation requires that the functions must be solutions of Eq. (I.16), a two dimensional wave equation plus time. This is consistent with first principle laws and ultimately matches experimentation. However, it is unconventional.

The two dimensional wave equation plus time is given by McQuarrie [2]. It is mathematically identical to the familiar rigid rotor equation of QM. The electron is confined to two dimensions (θ and ϕ) plus time, and the corresponding wave equation solution is called an electron orbitsphere. Spherical harmonic functions and time harmonic functions are well known solutions of the angular and time components of the two dimensional wave equation plus time, respectively. The solutions appear in McQuarrie [3]. A constant current function is also a solution of the wave equation. A constant function corresponding to the electron spin function is added to each of the spherical harmonic functions to give the charge (mass)-density functions of the electron as a function of time. The integral of a spherical harmonic function over the orbitsphere is zero. The integral of the constant function over the orbitsphere is the total charge (mass) of the electron. These functions comprise the well known s, p, d, f, etc. electrons or orbitals. In the case that such an electron state arises as an excited state by photon absorption, it is radiative due to a radial dipole term in its current-density function since it possesses spacetime Fourier components synchronous with waves traveling at the speed of light as shown in the Instability of the Excited States section.

The excited states are solved including the radii of the orbitspheres using Maxwell's equations with the traditional source current boundary

constraints at the electron. Quantization arises from the equation of the photon and the electron—not from the solution of the electron alone. After all, each solution models an excited state created by the absorption of a photon. The solutions are analogous to those of excited resonator modes except that the cavity is dynamic. The field lines from the proton end on the current-density function of the electron, and the electric field is zero for $r > r_n$. The trapped photons are a solution of the three dimensional wave equation plus time given by Maxwell's equations. The electrodynamic field of the photon is a constant function plus a time and spherical harmonic function that is in phase with source currents at the electron which is given by a constant plus a time and spherical harmonic function. Only particular solutions are possible as resonant photons of the electron which is a dynamic resonator cavity. The results are in agreement with first principle physics and experimental observations of the hydrogen atom, excited states, free electron, and free space photon including the wave particle duality aspects.

SPIN AND ORBITAL PARAMETERS ARISE FROM FIRST PRINCIPLES

An electron is a spinning, two-dimensional spherical surface, called an *electron orbitsphere*, that can exist in a bound state only at specific radii r_n from the nucleus. (See Figure 1.1 for a pictorial representation of an orbitsphere.) The result for the $n = 1$ state of hydrogen is that the charge-density function remains constant with each point on the surface moving at the same angular and linear velocity. The constant function solution of the two dimensional wave equation corresponds to the spin function which has a corresponding spin angular momentum that may be calculated from $\mathbf{r} \times \mathbf{p}$ applied directly to the current-density function that describes the electron. The radius of the nonradiative ($n = 1$) state is solved using the electromagnetic force equations of Maxwell relating the charge and mass-density functions wherein the angular momentum of the electron is $\hbar$ (Eq. (1.165)). The reduced mass arises naturally from an electrodynamic interaction between the electron and the proton rather than from a point mass revolving around a point nucleus in the case of Schrödinger wave equation solutions which presents an internal inconsistency since the wave functions are spherically symmetrical.

CQM gives closed form solutions for the resonant photons and excited state electron functions. The free space photon also comprises a radial Dirac delta function, and the angular momentum of the photon given by $\mathbf{m} = \int \frac{1}{8\pi c} \mathrm{Re}[\mathbf{r} \times (\mathbf{E} \times \mathbf{B}^*)] dx^4 = \hbar$ in the Photon section is conserved for the solutions for the resonant photons and excited state electron functions. It can be demonstrated that the resonance condition between these frequencies is to be satisfied in order to have a net change of the energy field [4]. In the present case, the correspondence principle

holds. That is the change in angular frequency of the electron is equal to the angular frequency of the resonant photon that excites the resonator cavity mode corresponding to the transition, and the energy is given by Planck's equation. The predicted energies, Lamb shift, fine structure splitting, hyperfine structure, resonant line shape, line width, selection rules, etc. are in agreement with observation.

The radii of excited states are solved using the electromagnetic force equations of Maxwell relating the field from the charge of the proton, the electric field of the photon, and charge and mass-density functions of the electron wherein the angular momentum of the electron is $\hbar$ (Eq. (1.165)).

For excited states of the hydrogen atom, the constant function solution of the two dimensional wave equation corresponds to the spin function. Each spherical harmonic function modulates the constant spin function and corresponds to an orbital function of a specific excited state with a corresponding phase-matched trapped photon and orbital angular momentum. Thus, the spherical harmonic function behaves as a charge-density wave which travels time harmonically on the surface of the orbitsphere about a specific axis. (See Figure 1.2 for a pictorial representation.) The amplitude of the corresponding orbital energy may be calculated from Maxwell's equations. Since the constant function is modulated harmonically, the time average of the orbital energy is zero except in the presence of a magnetic field. Nondegeneracy of energy levels arises from spin, orbital, and spin-orbital coupling interactions with the applied field. The electrodynamic interaction with the magnetic field gives rise to the observed hyperfine splitting of the hydrogen spectrum.

Many inconsistencies arise in the case of the corresponding solutions of the Schrödinger wave equation. For example, where is the photon in excited states given by the Schrödinger equation? And, a paradox arises for the change in angular momentum due to photon absorption. The Schrödinger equation solutions for the kinetic energy of rotation K_{rot} is given by Eq. (10) of ref. [5] and the value of the electron angular momentum L for the state $Y_{lm}(\theta,\phi)$ is given by Eq. (11) of ref. [5]. They predict that the excited state rotational energy levels are nondegenerate as a function of the ℓ quantum number even in the absence of an applied magnetic field, and the predicted energy is over six orders of magnitude of the observed nondegenerate energy in the presence of a magnetic field. In the absence of a magnetic field, no preferred direction exists. In this case, the ℓ quantum number is a function of the orientation of the atom with respect to an arbitrary coordinate system. Therefore, the nondegeneracy is nonsensical and violates conservation of angular momentum of the photon.

In quantum mechanics, the spin angular momentum of the electron is called the "intrinsic angular momentum" since no physical interpretation exists. The Schrödinger equation is not Lorentzian invariant in violation of special relativity. It fails to predict the results of the Stern-Gerlach experiment which indicates the need for an additional quantum number. Quantum Electrodynamics (QED) was proposed by Dirac in 1926 to provide a generalization of quantum mechanics for high energies in conformity with the theory of special relativity and to provide a consistent treatment of the interaction of matter with radiation. It is fatally flawed. From Weisskopf [6], "Dirac's quantum electrodynamics gave a more consistent derivation of the results of the correspondence principle, but it also brought about a number of new and serious difficulties." Quantum electrodynamics; 1.) DOES NOT EXPLAIN NONRADIATION OF BOUND ELECTRONS; 2.) contains an internal inconsistency with special relativity regarding the classical electron radius—the electron mass corresponding to its electric energy is infinite (the Schrödinger equation fails to predict the classical electron radius); 3.) it admits solutions of negative rest mass and negative kinetic energy; 4.) the interaction of the electron with the predicted zero-point field fluctuations leads to infinite kinetic energy and infinite electron mass; 5.) Dirac used the unacceptable states of negative mass for the description of the vacuum; yet, infinities still arise. Dirac's equation which was postulated to explain spin relies on the unfounded notions of negative energy states of the vacuum, virtual particles, and gamma factors. All of these features are untenable or are inconsistent with observation. These problems regarding spin and orbital angular momentum and energies and the classical electron radius are nonexistent with CQM solutions.

Furthermore, the mathematical relationship whereby the Schrödinger equation may be transformed into a form consistent with first principles is shown *infra*. In the case that the potential energy of the Hamiltonian, H, is a constant times the wavenumber, the Schrödinger equation is the well known Bessel equation. Then one of the solutions for the wavefunction Ψ (a current-density function rather than a probability wave) is equivalent to an inverse Fourier transform. According to the duality and scale change properties of Fourier transforms, the energy equation of CQM and that of quantum mechanics are identical, the energy of a radial Dirac delta function of radius equal to an integer multiple of the radius of the hydrogen atom.

CLASSICAL QUANTUM THEORY

One-electron atoms include the hydrogen atom, He^{+}, Li^{2+}, Be^{3+}, and so on. The mass-energy and angular momentum of the electron are constant; this requires that the equation of motion of the electron be temporally and spatially harmonic. Thus, the classical wave equation applies and

$$\left[\nabla^2-\frac{1}{v^2}\frac{\partial^2}{\partial t^2}\right]\rho(r,\theta,\phi,t)=0 \tag{I.2}$$

where $\rho(r,\theta,\phi,t)$ is the charge-density function of the electron in time and space. In general, the wave equation has an infinite number of solutions. To arrive at the solution which represents the electron, a suitable boundary condition must be imposed. It is well known from experiments that each single atomic electron of a given isotope radiates to the same stable state. Thus, CQM uses the physical boundary condition of nonradiation of the bound electron to be imposed on the solution of the wave equation for the charge-density function of the electron. The condition for radiation by a moving point charge given by Haus [7] is that its spacetime Fourier transform possesses components that are synchronous with waves traveling at the speed of light. Conversely, it is proposed that the condition for nonradiation by an ensemble of moving point charges that comprises a charge-density function is

For non-radiative states, the current-density function must NOT possess spacetime Fourier components that are synchronous with waves traveling at the speed of light.

The Haus derivation applies to a moving charge-density function as well because charge obeys superposition. The Haus derivation is summarized below.

The Fourier components of the current produced by the moving charge are derived. The electric field is found from the vector equation in Fourier space ($\mathbf{k}$, ω-space). The inverse Fourier transform is carried over the magnitude of $\mathbf{k}$. The resulting expression demonstrates that the radiation field is proportional to $\mathbf{J}_\perp(\frac{\omega}{c}\mathbf{n},\omega)$, where $\mathbf{J}_\perp(\mathbf{k},\omega)$ is the spacetime Fourier transform of the current perpendicular to $\mathbf{k}$ and $\mathbf{n}\equiv\frac{\mathbf{k}}{|k|}$. Specifically,

$$\mathbf{E}_\perp(\mathbf{r},\omega)\frac{d\omega}{2\pi}=\frac{c}{2\pi}\int\rho(\omega,\Omega)d\omega d\Omega\sqrt{\frac{\mu_0}{\varepsilon_0}}\mathbf{n}\,X\left(\mathbf{n}\,X\,\mathbf{J}_\perp\left(\frac{\omega}{c}\mathbf{n},\omega\right)e^{i\left(\frac{\omega}{c}\right)\mathbf{n}\bullet\mathbf{r}}\right) \tag{I.3}$$

The field $\mathbf{E}_\perp(\mathbf{r},\omega)\frac{d\omega}{2\pi}$ is proportional to $\mathbf{J}_\perp\left(\frac{\omega}{c}\mathbf{n},\omega\right)$, namely, the Fourier component for which $\mathbf{k}=\frac{\omega}{c}$. Factors of ω that multiply the Fourier component of the current are due to the density of modes per unit volume and unit solid angle. An unaccelerated charge does not radiate in free space, not because it experiences no acceleration, but because it has no Fourier component $\mathbf{J}_\perp\left(\frac{\omega}{c}\mathbf{n},\omega\right)$. (Nonradiation is also shown directly using

Maxwell's equations in Appendix I: Nonradiation Based on the Electromagnetic Fields and the Poynting Power Vector.)

The time, radial, and angular solutions of the wave equation are separable. The motion is time harmonic with frequency ω_n. To be a harmonic solution of the wave equation in spherical coordinates, the angular functions must be spherical harmonic functions. A zero of the spacetime Fourier transform of the product function of two spherical harmonic angular functions, a time harmonic function, and an unknown radial function is sought. The solution for the radial function which satisfies the boundary condition is a delta function

$$f(r) = \frac{1}{r^2}\delta(r - r_n) \tag{I.4}$$

where $r_n = nr_1$ is an allowed radius. Thus, bound electrons are described by a charge-density (mass-density) function which is the product of a radial delta function ($f(r) = \frac{1}{r^2}\delta(r - r_n)$), two angular functions (spherical harmonic functions), and a time harmonic function. Thus, an electron is a spinning, two-dimensional spherical surface, called an *electron orbitsphere*, that can exist in a bound state at only specified distances from the nucleus as shown in Figure 1.1. More explicitly, the orbitsphere comprises a two-dimensional spherical shell of moving charge.

The total function that describes the spinning motion of each electron orbitsphere is composed of two functions. One function, the spin function, is spatially uniform over the orbitsphere, spins with a quantized angular velocity, and gives rise to spin angular momentum. The other function, the modulation function, can be spatially uniform—in which case there is no orbital angular momentum and the magnetic moment of the electron orbitsphere is one Bohr magneton—or not spatially uniform—in which case there is orbital angular momentum. The modulation function also rotates with a quantized angular velocity.

The uniform current density function $Y_0^0(\phi,\theta)$, the orbitsphere equation of motion of the electron (Eqs. (1.64-1.65)), corresponding to the constant charge function of the orbitsphere that gives rise to the spin of the electron is generated from a basis set current-vector field defined as the orbitsphere current-vector field ("orbitsphere-cvf"). This in turn is generated from orthogonal great circle current loops that serve as basis elements. In Appendix III, the *continuous* uniform electron current density function $Y_0^0(\phi,\theta)$ (Eqs. (1.64-1.65)) is then exactly generated from this orbitsphere-cvf as a basis element by a convolution operator comprising an autocorrelation-type function.

The orbitsphere-cvf comprises an infinite series of correlated orthogonal great circle current loops. The current pattern is generated over the surface by two sets of an infinite series of nested rotations of two

orthogonal great circle current loops where the coordinate axes rotate with the two orthogonal great circles. Each infinitesimal rotation of the infinite series is about the new i'-axis and new j'-axis which results from the preceding such rotation. For each of the two sets of nested rotations, the angular sum of the rotations about each rotating i'-axis and j'-axis totals $\frac{\sqrt{2}}{2}\pi$ radians.

Consider the electron to be evenly distributed within two sets of orthogonal great circle current loops for Steps One and Two. Then, consider two infinitesimal point mass (charge)-density elements, one and two, of one set of two orthogonal great circle current loops wherein initially the first current loop lies in the yz-plane, and the second current loop lies in the xz-plane. The xyz Cartesian coordinate frame is designated the laboratory reference frame. The algorithm to generate the orbitsphere-cvf rotates the great circles and the corresponding coordinates relative to the xyz frame. A primed Cartesian coordinate system refers to the axes that rotate with the great circles and determines the basis-set reference frame. Each element of the current pattern is obtained with each conjugate set of rotations. For Step One, consider two such infinitesimal charges (masses) at points one (moving counter clockwise on the great circle in the y'z'-plane) and two (moving clockwise on the great circle in the x'z'-plane) of two orthogonal great circle current loops in the basis frame are considered as sub-basis elements to generate the current density corresponding to the spin quantum number, $s=\frac{1}{2};\ m_s=\pm\frac{1}{2}$. Initially element one is at $x'=0$, $y'=0$, and $z'=r_n$ and element two is at $x'=r_n$, $y'=0$, and $z'=0$ as shown in Figure 1.4A. The equations of motion, in the sub-basis-set reference frame are given by

point one:

$$x_1'=0 \qquad y_1'=-r_n\sin(\omega_n t) \qquad z_1'=r_n\cos(\omega_n t) \tag{I.5a}$$

point two:

$$x_2'=r_n\cos(\omega_n t) \qquad y_2'=0 \qquad z_2'=r_n\sin(\omega_n t) \tag{I.5b}$$

For Step Two, consider two charge (mass)-density elements, point one and two, in the basis-set reference frame at time zero. Element one is at $x'=0$, $y'=r_n$, and $z'=0$ and element two is at $x'=r_n$, $y'=0$, and $z'=0$. Let element one move clockwise on a great circle toward the -z'-axis as shown in Figure 1.4B, and let element two move counter clockwise on a great circle toward the y'-axis as shown in Figure 1.4B. The equations of motion, in the basis-set reference frame are given by

point one:

$$x_1^{'} = 0 \qquad y_1^{'} = r_n \cos(\omega_n t) \qquad z_1^{'} = -r_n \sin(\omega_n t) \tag{I.6a}$$

point two:

$$x_2^{'} = r_n \cos(\omega_n t) \qquad y_2^{'} = r_n \sin(\omega_n t) \qquad z_2^{'} = 0 \tag{I.6b}$$

The great circles are rotated by an infinitesimal angle $\pm\Delta\alpha_{i'}$ (a rotation around the x'-axis or z'-axis for Steps One and Two, respectively) and then by $\pm\Delta\alpha_{j'}$ (a rotation around the new y'-axis or x'-axis for Steps One and Two, respectively) where the rotation directions are shown in Figures 1.4A and 1.4B, respectively. The coordinates of each point on each rotated great circle (x',y',z') is expressed in terms of the first (x,y,z) coordinates by the following transforms where clockwise rotations are defined as positive:

Step One

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \cos(\Delta\alpha_y) & 0 & -\sin(\Delta\alpha_y) \\ 0 & 1 & 0 \\ \sin(\Delta\alpha_y) & 0 & \cos(\Delta\alpha_y) \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\Delta\alpha_x) & \sin(\Delta\alpha_x) \\ 0 & -\sin(\Delta\alpha_x) & \cos(\Delta\alpha_x) \end{bmatrix} \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \cos(\Delta\alpha_y) & \sin(\Delta\alpha_y)\sin(\Delta\alpha_x) & -\sin(\Delta\alpha_y)\cos(\Delta\alpha_x) \\ 0 & \cos(\Delta\alpha_x) & \sin(\Delta\alpha_x) \\ \sin(\Delta\alpha_y) & -\cos(\Delta\alpha_y)\sin(\Delta\alpha_x) & \cos(\Delta\alpha_y)\cos(\Delta\alpha_x) \end{bmatrix} \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix}$$

(I.7)

Step Two

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\Delta\alpha_x) & \sin(\Delta\alpha_x) \\ 0 & -\sin(\Delta\alpha_x) & \cos(\Delta\alpha_x) \end{bmatrix} \begin{bmatrix} \cos(\Delta\alpha_z) & \sin(\Delta\alpha_z) & 0 \\ -\sin(\Delta\alpha_z) & \cos(\Delta\alpha_z) & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \cos(\Delta\alpha_z) & \sin(\Delta\alpha_z) & 0 \\ -\cos(\Delta\alpha_x)\sin(\Delta\alpha_z) & \cos(\Delta\alpha_x)\cos(\Delta\alpha_z) & \sin(\Delta\alpha_x) \\ \sin(\Delta\alpha_x)\sin(\Delta\alpha_z) & -\sin(\Delta\alpha_x)\cos(\Delta\alpha_z) & \cos(\Delta\alpha_x) \end{bmatrix} \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} \tag{I.8}$$

where the angular sum is $\lim_{\Delta\alpha \to 0} \sum_{n=1}^{\frac{\frac{\sqrt{2}}{2}\pi}{|\Delta\alpha_{i',j'}|}} |\Delta\alpha_{i',j'}| = \frac{\sqrt{2}}{2}\pi$.

The orbitsphere-cvf is given by n reiterations of Eqs. (I.7) and (I.8) for each point on each of the two orthogonal great circles during each of Steps One and Two where the sign of $\pm\Delta\alpha_{i'}$ and $\pm\Delta\alpha_{j'}$ for each Step are given in Table 1.1. The output given by the non-primed coordinates is the input of the next iteration corresponding to each successive nested rotation by the infinitesimal angle $\pm\Delta\alpha_{i'}$ or $\pm\Delta\alpha_{j'}$ where the magnitude of the angular sum of the n rotations about each of the i'-axis and the j'-axis is $\frac{\sqrt{2}}{2}\pi$. Half of the orbitsphere-cvf is generated during each of Steps One and Two.

Following Step Two, in order to match the boundary condition that the magnitude of the velocity at any given point on the surface is given by Eq. (1.56), the output half of the orbitsphere-cvf is rotated clockwise by an angle of $\frac{\pi}{4}$ about the z-axis. Using Eq. (I.8) with $\Delta\alpha_{z'} = \frac{\pi}{4}$ and $\Delta\alpha_{x'} = 0$ gives the rotation. Then, the one half of the orbitsphere-cvf generated from Step One is superimposed with the complementary half obtained from Step Two following its rotation about the z-axis of $\frac{\pi}{4}$ to give the orbitsphere-cvf.

The current pattern of the orbitsphere-cvf generated by the nested rotations of the orthogonal great circle current loops is a continuous and

total coverage of the spherical surface, but it is shown as visual representations using 6 degree increments of the infinitesimal angular variable $\pm\Delta\alpha_{i'}$ and $\pm\Delta\alpha_{j'}$ of Eqs. (I.7) and (I.8) from six perspectives in Figures 1.5A-F. In each case, the complete orbitsphere-cvf current pattern corresponds to all the correlated points, points one and two, of the orthogonal great circles shown in Figures 1.4A and 1.4B which are rotated according to Eqs. (I.7) and (I.8) where $\pm\Delta\alpha_{i'}$ and $\pm\Delta\alpha_{j'}$ approach zero and the summation of the infinitesimal angular rotations of $\pm\Delta\alpha_{i'}$ and $\pm\Delta\alpha_{j'}$ about the successive i'-axes and j'-axes is $\frac{\sqrt{2}}{2}\pi$ for each Step. The current pattern gives rise to the phenomenon corresponding to the spin quantum number.

The resultant angular momentum projections of $\mathbf{L}_{xy}=\frac{\hbar}{4}$ and $\mathbf{L}_z=\frac{\hbar}{2}$ meet the boundary condition for the unique current having an angular velocity magnitude at each point on the surface given by Eq. (1.56) and give rise to the Stern Gerlach experiment as shown in the Magnetic Parameters of the Electron (Bohr Magneton) section, and in the Electron g Factor section. The further constraint that the current density is uniform such that the charge density is uniform, corresponding to an equipotential, minimum energy surface is satisfied by using the orbitsphere-cvf as a basis element to generate $Y_0^0(\phi,\theta)$ using a convolution operator comprising an autocorrelation-type function as given in Appendix III. The operator comprises the convolution of each great circle current loop of the orbitsphere-cvf designated as the primary orbitsphere-cvf with a second orbitsphere-cvf designated as the secondary orbitsphere-cvf.

The orbitsphere-cvf comprises two components corresponding to each of STEP ONE and STEP TWO. As shown for STEP TWO, the angular momentum vector is stationary on the $\left(-\frac{1}{\sqrt{2}}\mathbf{i}_x,\frac{1}{\sqrt{2}}\mathbf{i}_y,\mathbf{i}_z\right)$-axis as the component orbitsphere-cvf is generated by the series of nested rotations using Eq. (1.70b). It is shown in Appendix III that STEP TWO can also be generated by a 2π-rotation of a single basis-element current loop about the $\left(-\frac{1}{\sqrt{2}}\mathbf{i}_x,\frac{1}{\sqrt{2}}\mathbf{i}_y,\mathbf{i}_z\right)$-axis. In the general case that the resultant angular momentum of each pair of orthogonal great circle current loops of the component orbitsphere-cvf is along the 2π-rotational axis (defined as the rotational axis which generates the component orbitsphere-cvf from a basis-element great circle), a secondary nth component orbitsphere-cvf can serve as a basis element to match the angular momentum of any given nth great circle of a primary component orbitsphere-cvf. The replacement of each great circle of the primary orbitsphere-cvf with a secondary orbitsphere-cvf of matching angular momentum, orientation,

and phase comprises an autocorrelation-type function that exactly gives rise to the spherically-symmetric current density, $Y_0^{\,0}(\phi,\theta)$, as the sum of two uniform spherical contributions from each component. The resulting exact uniform current distribution obtained from the convolution has the same angular momentum distribution, resultant, $\mathbf{L_R}$, and components of $\mathbf{L}_{xy} = \frac{\hbar}{4}$ and $\mathbf{L}_z = \frac{\hbar}{2}$ as those of the orbitsphere-cvf used as a primary basis element.

In contrast to the QM and QED cases (See Appendix II: Quantum Electrodynamics is Purely Mathematical and Has No Basis in Reality), the fourth quantum number arises naturally in CQM as derived in the Electron g Factor section. The Stern-Gerlach experiment implies a magnetic moment of one Bohr magneton and an associated angular momentum quantum number of 1/2. Historically, this quantum number is called the spin quantum number, s ($s = \frac{1}{2}$; $m_s = \pm\frac{1}{2}$). Conservation of angular momentum of the orbitsphere permits a discrete change of its "kinetic angular momentum" $(\mathbf{r} \times m\mathbf{v})$ with respect to the field of $\frac{\hbar}{2}$, and concomitantly the "potential angular momentum" $(\mathbf{r} \times e\mathbf{A})$ must change by $-\frac{\hbar}{2}$. The flux change, ϕ, of the orbitsphere for $r < r_n$ is determined as follows:

$$\Delta\mathbf{L} = \frac{\hbar}{2} - \mathbf{r} \times e\mathbf{A} \tag{I.9}$$

$$= \left[\frac{\hbar}{2} - \frac{e2\pi rA}{2\pi}\right]\hat{z} \tag{I.10}$$

$$= \left[\frac{\hbar}{2} - \frac{e\phi}{2\pi}\right]\hat{z} \tag{I.11}$$

In order that the change of angular momentum, $\Delta\mathbf{L}$, equals zero, ϕ must be $\Phi_0 = \frac{h}{2e}$, the magnetic flux quantum. Thus, to conserve angular momentum in the presence of an applied magnetic field, the orbitsphere magnetic moment can be parallel or antiparallel to an applied field as observed with the Stern-Gerlach experiment, and the flip between orientations is accompanied by the "capture" of the magnetic flux quantum by the orbitsphere. During the spin-flip transition, power must be conserved. Power flow is governed by the Poynting power theorem,

$$\nabla \bullet (\mathbf{E} \times \mathbf{H}) = -\frac{\partial}{\partial t}\left[\frac{1}{2}\mu_o \mathbf{H} \bullet \mathbf{H}\right] - \frac{\partial}{\partial t}\left[\frac{1}{2}\varepsilon_o \mathbf{E} \bullet \mathbf{E}\right] - \mathbf{J} \bullet \mathbf{E} \tag{I.12}$$

Eq. (I.13) derived in the Electron g Factor section gives the total energy of the flip transition which is the sum of the energy of reorientation of the magnetic moment (1st term), the magnetic energy (2nd term), the electric

energy (3rd term), and the dissipated energy of a fluxon treading the orbitsphere (4th term), respectively.

$$\Delta E_{mag}^{spin} = 2\left(1 + \frac{\alpha}{2\pi} + \frac{2}{3}\alpha^2\left(\frac{\alpha}{2\pi}\right) - \frac{4}{3}\left(\frac{\alpha}{2\pi}\right)^2\right)\mu_B B \quad (I.13)$$

$$\Delta E_{mag}^{spin} = g\mu_B B \quad (I.14)$$

The spin-flip transition can be considered as involving a magnetic moment of g times that of a Bohr magneton. The g factor is redesignated the fluxon g factor as opposed to the anomalous g factor. The calculated value of $\frac{g}{2}$ is $1.001\ 159\ 652\ 137$. The experimental value [8] of $\frac{g}{2}$ is $1.001\ 159\ 652\ 188(4)$.

CQM solves the wave equation for the charge-density function of the electron. The time, radial, and angular solutions of the wave equation are separable. Also, the radial function for the electron indicates that the electron is two-dimensional. Therefore, the angular mass-density function of the electron, $A(\theta, \phi, t)$, must be a solution of the wave equation in two dimensions (plus time). EQ. (I.2) becomes

$$\left[\nabla^2 - \frac{1}{v^2}\frac{\partial^2}{\partial t^2}\right]A(\theta, \phi, t) = 0 \quad (I.15)$$

where $\rho(r, \theta, \phi, t) = f(r)A(\theta, \phi, t) = \frac{1}{r^2}\delta(r - r_n)A(\theta, \phi, t)$ and $A(\theta, \phi, t) = Y(\theta, \phi)k(t)$. Specifically, the wave equation is

$$\left[\frac{1}{r^2 \sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial}{\partial\theta}\right)_{r,\phi} + \frac{1}{r^2\sin^2\theta}\left(\frac{\partial^2}{\partial\phi^2}\right)_{r,\theta} - \frac{1}{v^2}\frac{\partial^2}{\partial t^2}\right]A(\theta, \phi, t) = 0 \quad (I.16)$$

where v is the linear velocity of the electron. The charge-density functions including the time-function factor are

$\ell = 0$

$$\rho(r,\theta,\phi,t) = \frac{e}{8\pi r^2}[\delta(r - r_n)]\left[Y_0^0(\theta,\phi) + Y_\ell^m(\theta,\phi)\right] \quad (I.17)$$

$\ell \neq 0$

$$\rho(r,\theta,\phi,t) = \frac{e}{4\pi r^2}[\delta(r - r_n)]\left[Y_0^0(\theta,\phi) + \mathrm{Re}\left\{Y_\ell^m(\theta,\phi)e^{i\omega_n t}\right\}\right] \quad (I.18)$$

where $\mathrm{Re}\left\{Y_\ell^m(\theta,\phi)e^{i\omega_n t}\right\} = P_\ell^m(\cos\theta)\cos(m\phi + \omega_n' t)$ and to keep the form of the spherical harmonic as a traveling wave about the z-axis, $\omega_n' = m\omega_n$.

The spin function of the electron (see Figure 1.1 for the charge function and Figure 1.5A for the current function) corresponds to the nonradiative $n = 1$, $\ell = 0$ state of atomic hydrogen which is well known as an s state or orbital. The constant spin function is modulated by a time and spherical harmonic function as given by Eq. (I.18) and shown in

Figure 1.2. The modulation or traveling charge-density wave corresponds to an orbital angular momentum in addition to a spin angular momentum. These states are typically referred to as p, d, f, etc. orbitals and correspond to an ℓ quantum number not equal to zero. Application of the condition from Haus [7] (Eqs, (I.19-I.21)) also predicts nonradiation for a constant spin function modulated by a time and spherically harmonic orbital function. There is acceleration without radiation. (Also see Abbott and Griffiths and Goedecke [9-10]). Nonradiation is also shown directly using Maxwell's equations in Appendix I: Nonradiation Based on the Electromagnetic Fields and the Poynting Power Vector. However, in the case that such a state arises as an excited state by photon absorption, it is radiative due to a radial dipole term in its current-density function since it possesses spacetime Fourier transform components synchronous with waves traveling at the speed of light as shown in the Instability of Excited States section.

The Fourier transform of the electron charge-density function is a solution of the four-dimensional wave equation in frequency space (**k**, ω-space). Then the corresponding Fourier transform of the current-density function $K(s,\Theta,\Phi,\omega)$ is given by multiplying by the constant angular frequency.

$$K(s,\Theta,\Phi,\omega) = 4\pi\omega_n \frac{\sin(2s_n r_n)}{2s_n r_n} \otimes 2\pi \sum_{\upsilon=1}^{\infty} \frac{(-1)^{\upsilon-1}(\pi\sin\Theta)^{2(\upsilon-1)}}{(\upsilon-1)!(\upsilon-1)!} \frac{\Gamma\left(\frac{1}{2}\right)\Gamma\left(\upsilon+\frac{1}{2}\right)}{(\pi\cos\Theta)^{2\upsilon+1}2^{\upsilon+1}} \frac{2\upsilon!}{(\upsilon-1)!} s^{-2\upsilon}$$
$$\otimes 2\pi \sum_{\upsilon=1}^{\infty} \frac{(-1)^{\upsilon-1}(\pi\sin\Phi)^{2(\upsilon-1)}}{(\upsilon-1)!(\upsilon-1)!} \frac{\Gamma\left(\frac{1}{2}\right)\Gamma\left(\upsilon+\frac{1}{2}\right)}{(\pi\cos\Phi)^{2\upsilon+1}2^{\upsilon+1}} \frac{2\upsilon!}{(\upsilon-1)!} s^{-2\upsilon} \frac{1}{4\pi}[\delta(\omega-\omega_n)+\delta(\omega+\omega_n)] \tag{I.19}$$

The motion on the orbitsphere is angular; however, a radial component exists due to special relativistic effects. Consider the radial wave vector of the sinc function. When the radial projection of the velocity is c

$$\mathbf{s}_n \bullet \mathbf{v}_n = \mathbf{s}_n \bullet \mathbf{c} = \omega_n \tag{I.20}$$

the relativistically corrected wavelength is

$$r_n = \lambda_n \tag{I.21}$$

(i.e. the lab frame motion in the angular direction goes to zero as the velocity approaches the speed of light). Substitution of Eq. (I.21) into the sinc function results in the vanishing of the entire Fourier transform of the current-density function. Thus, spacetime harmonics of $\frac{\omega_n}{c} = k$ or $\frac{\omega_n}{c}\sqrt{\frac{\varepsilon}{\varepsilon_o}} = k$ for which the Fourier transform of the current-density function is nonzero do not exist. Radiation due to charge motion does not occur in any medium when this boundary condition is met.

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Section 64

Examiner Souw further demonstrates a disturbing lack of understanding of Applicant's disclosed invention with his statements on pages 18-19 of the Appendix that:

> (2) Applicant's allegation that QM is inconsistent with experimental observation is doubly flawed. Firstly, the fact that hydrogen ground state (n=1) does not radiate is confirmed by experimental observations without a single exception, as already recited in the previous Appendix. Secondly, Applicant's insistence that the n=1 state *does radiate* is not supported by any valid experimental evidence. Applicant's own "experimental evidence" (if any) must be disqualified, because it can not be confirmed by any independent third party researcher.

Applicant agrees with the Examiner's statement that "the fact that hydrogen ground state (n=1) does not radiate is confirmed by experimental observations without a single exception". Applicant uses this as the basis to solve the hydrogen atom rather than using a purely mathematical boundary condition as in the case of SQM, as discussed in Section 63 above.

Applicant, however, does not agree with the Examiner's further statement regarding "Applicant's insistence that the n=1 state *does radiate*." That statement proves that the Examiner does not have even a basic understanding of Applicant's disclosed invention. The patent specification, Applicant's 112 publications, as well as some of the papers from the section entitled "Independent Test Results" disclose the resonant, **nonradiative** energy transfer from the hydrogen atom to the catalyst. For example, from:

67. R. L. Mills, P. Ray, "Extreme Ultraviolet Spectroscopy of Helium-Hydrogen Plasma", J. Phys. D, Applied Physics, Vol. 36, (2003), pp. 1535-1542.

The elimination of known explanations indicate a new result. Since the novel peaks were only observed with helium and hydrogen present, new hydrogen, helium, or helium-hydrogen species are possibilities. It is well known that empirically the excited energy states of atomic hydrogen are given by Rydberg equation (Eq. (2a) for $n > 1$ in Eq. (2b)).

$$E_n = -\frac{e^2}{n^2 8\pi\varepsilon_o a_H} = -\frac{13.598\ eV}{n^2} \tag{2a}$$

$$n = 1,2,3,\ldots \tag{2b}$$

The $n = 1$ state is the "ground" state for "pure" photon transitions (i.e. the $n = 1$ state can absorb a photon and go to an excited electronic state, but it cannot release a photon and go to a lower-energy electronic state). However, an electron transition from the ground state to a lower-energy state may be possible by a resonant nonradiative energy transfer such as multipole coupling or a resonant collision mechanism. Processes such as hydrogen molecular bond formation that occur without photons and that require collisions are common [47]. Also, some commercial phosphors are based on resonant nonradiative energy transfer involving multipole coupling [48].

We propose that atomic hydrogen may undergo a catalytic reaction with certain atoms and ions such as He^+ which singly or multiply ionize at integer multiples of the potential energy of atomic hydrogen, $m \cdot 27.2\ eV$ wherein m is an integer. The theory was given previously [49]. The reaction involves a nonradiative energy transfer to form a hydrogen atom

that is lower in energy than unreacted atomic hydrogen that corresponds to a fractional principal quantum number. That is

$$n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \ldots, \frac{1}{p}; \quad p \text{ is an integer; } p \le 137 \tag{2c}$$

replaces the well known parameter $n = \text{integer}$ in the Rydberg equation for hydrogen excited states. Thus, the Rydberg states are extended to lower levels as depicted in Figure 9. The $n = 1$ state of hydrogen and the $n = \frac{1}{\text{integer}}$ states of hydrogen are nonradiative, but a transition between two nonradiative states is possible via a nonradiative energy transfer, say $n = 1$ to $n = 1/2$. Thus, a catalyst provides a net positive enthalpy of reaction of $m \cdot 27.2\ eV$ (i.e. it resonantly accepts the nonradiative energy transfer from hydrogen atoms and releases the energy to the surroundings to affect electronic transitions to fractional quantum energy levels). As a consequence of the nonradiative energy transfer, the hydrogen atom becomes unstable and emits further energy until it achieves a lower-energy nonradiative state having a principal energy level given by Eqs. (2a) and (2c).

The novel peaks fit two empirical relationships. In order of energy, the set comprising the peaks at $91.2\ nm$, $45.6\ nm$, $30.4\ nm$, $13.03\ nm$, $10.13\ nm$, and $8.29\ nm$ correspond to energies of $q \cdot 13.6\ eV$ where $q = 1,2,3,7,9,11$. In order of energy, the set comprising the peaks at $37.4\ nm$, $20.5\ nm$, and $14.15\ nm$ correspond to energies of $q \cdot 13.6 - 21.21\ eV$ where $q = 4,6,8$. These lines can be explained as electronic transitions to fractional Rydberg states of atomic hydrogen given by Eqs. (2a) and (2c) wherein the catalytic system involves helium ions because the second ionization energy of helium is $54.417\ eV$, which is equivalent to $2 \cdot 27.2\ eV$. In this case, $54.417\ eV$ is transferred nonradiatively from atomic hydrogen to He^{+} which is resonantly ionized. The electron decays to the $n = 1/3$ state with the further release of $54.417\ eV$ which may be emitted as a photon. The catalysis reaction is

$$54.417\ eV + He^{+} + H[a_H] \rightarrow He^{2+} + e^{-} + H\left[\frac{a_H}{3}\right] + 108.8\ eV \tag{3}$$

$$He^{2+} + e^{-} \rightarrow He^{+} + 54.417\ eV \tag{4}$$

And, the overall reaction is

$$H[a_H] \rightarrow H\left[\frac{a_H}{3}\right] + 54.4\ eV + 54.4\ eV \tag{5}$$

Since the products of the catalysis reaction have binding energies of $m \cdot 27.2\ eV$, they may further serve as catalysts. Thus, further catalytic transitions may occur: $n = \frac{1}{3} \rightarrow \frac{1}{4}$, $\frac{1}{4} \rightarrow \frac{1}{5}$, and so on.

Electronic transitions to Rydberg states given by Eqs. (2a) and (2c) catalyzed by the resonant nonradiative transfer of $m \cdot 27.2\ eV$ would give rise to a series of emission lines of energies $q \cdot 13.6\ eV$ where q is an integer. It is further proposed that the photons that arise from hydrogen

transitions may undergo inelastic helium scattering. That is, the catalytic reaction

$$H[a_H] \xrightarrow{He^+} H\left[\frac{a_H}{3}\right] + 54.4\ eV + 54.4\ eV \tag{6}$$

yields $54.4\ eV$ by Eq. (4) and a photon of $54.4\ eV$ ($22.8\ nm$). Once emitted, the photon may be absorbed or scattered. When this photon strikes $He\ (1s^2)$, $21.2\ eV$ may be absorbed in the excitation to $He\ (1s^1 2p^1)$. This leaves a $33.19\ eV$ ($37.4\ nm$) photon peak and a $21.21\ eV$ ($58.4\ nm$) photon from $He\ (1s^1 2p^1)$. Thus, for helium the inelastic scattered peak of $54.4\ eV$ photons from Eq. (3) is given by

$$E = 54.4\ eV - 21.21\ eV = 33.19\ eV\ (37.4\ nm) \tag{7}$$

A novel peak shown in Figures 2-4 was observed at $37.4\ nm$. Furthermore, the intensity of the $58.4\ nm$ peak corresponding to the spectra shown in Figure 4 was about 60,000 photons/sec. Thus, the transition $He\ (1s^2) \rightarrow He\ (1s^1 2p^1)$ dominated the inelastic scattering of EUV peaks. The general reaction is

$$photon\ (h\nu) + He\ (1s^2) \rightarrow He\ (1s^1 2p^1) + photon\ (h\nu - 21.21\ eV) \tag{8}$$

The two empirical series may be combined—one directly from Eqs. (2a, 2c) and the other indirectly with Eq. (8). The energies for the novel lines in order of energy are $13.6\ eV$, $27.2\ eV$, $40.8\ eV$, $54.4\ eV$, $81.6\ eV$, $95.2\ eV$, $108.8\ eV$, $122.4\ eV$ and $149.6\ eV$. The corresponding peaks are $91.2\ nm$, $45.6\ nm$, $30.4\ nm$, $37.4\ nm$, $20.5\ nm$, $13.03\ nm$, $14.15\ nm$, $10.13\ nm$, and $8.29\ nm$, respectively. Thus, the identified novel lines correspond to energies of $q \cdot 13.6\ eV$, $q = 1,2,3,7,9,11.$ or $q \cdot 13.6\ eV$, $q = 4,6,8$ less $21.2\ eV$ corresponding to inelastic scattering of these photons by helium atoms due to excitation of $He\ (1s^2)$ to $He\ (1s^1 2p^1)$. The values of q observed are consistent with those expected based on Eq. (5) and the subsequent autocatalyzed reactions as discussed previously [50]. The broad satellite peak at $44.2\ nm$ show in Figure 2-4 is consistent with the reaction mechanism of a nonradiative transfer to a catalyst followed by emission. There is remarkable agreement between the data and the proposed transitions to fractional Rydberg states and these lines inelastically scattered by helium according to Eq. (8). All other peaks could be assigned to He I, He II, second order lines, or atomic or molecular hydrogen emission. No known lines of helium or hydrogen explain the $q \cdot 13.6\ eV$ related set of peaks.

The above data disqualifies the Examiner's further statement regarding lack of support by "any valid experimental evidence." The body of evidence that experimentally confirms hydrino is overwhelming and has been extensively validated as given in the Experimental sections of this Response.

<u>Section 65</u>

Examiner Souw further asserts on page 19 of this Appendix that:

> (3) Applicant's arguments based on Laloë's article [5] are unpersuasive for reasons to be discussed in a section 6, sub-paragraph (d) below.

It is the Examiners arguments that are unpersuasive and prove that SQM is not based on physical laws. In fact, the Laloë's article demonstrates that it is hard to agree on what SQM is based on anything other than a belief system founded on postulates that gives rise to scenarios and consequences that are in contradiction with physical laws.

Section 66

On page 19 of his Appendix, Examiner Souw again improperly dismisses Applicant's scientific evidence, stating:

> (4) Reference [80] is to be disqualified, since it is written by Applicant based on his own flawed theory which has been addressed numerous times by the Examiner.

Other theoreticians, such as those at Princeton University, agree with Applicant's arguments given in [80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted] that the Heisenberg Uncertainty Principle provides no atomic stability [E. H. Lieb, "The stability of matter", Reviews of Modern Physics, Vol. 48, No. 4, (1976), pp, 553-569].

Section 67

Examiner Souw commits additional errors in his statement on page 19 of the Appendix that:

> (5) The proof given by Feynman that has removed the problem of self-radiation in an orbiting electron by virtue of the Heisenberg Uncertainty Principle (HUP) is scientifically convincing and well-accepted by the scientific community, while having been also <u>independently</u> confirmed based on exactly the same reason by the Examiner in the previous Appendix (same section 2, pg.2, lines 1-10; see also sect. 2.c above). This means, <u>the scientific community generally agrees with Feynman and the Examiner, but disagrees with Applicant</u>.

This is NOT TRUE. Lieb [34] also addresses the fact that the Schrödinger equation has been accepted for over a half of a century without addressing the stability of matter. Lieb also shows that the Feynman argument is "false" due to an inappropriate application of the Heisenberg Uncertainty Principle and admonishes the misrepresentation in textbooks. By considering a wavefunction comprised of two components at two radii such that the electron can not have both sharply defined momentum and position in accordance with the Uncertainty Principle, Lieb shows that the radius can be arbitrarily small including zero such that the energy is negative infinity. This result is obviously not predictive of stability.

Furthermore, the approach by Feynman and Lieb are physically baseless. Attempts to prove that a system has a kinetic energy that exceeds some lower bound such that the total energy is not negative infinity is not based on physics since it ignores radiation-loss terms. More recently, Bugliaro at al. [35] have attempted to use QED to prove the stability of matter with N nonrelativistic electrons and K static nuclei of nuclear charge $\leq Ze$ that can interact with photons. Here, the problem is "rigged" since the radiation field is defined to be quantized, an ultraviolet cutoff is arbitrarily imposed, Maxwell's equations are not obeyed due to the defined properties of the polarizations, and creation and annihilation operators including the limitation of the couplings of photons to electrons via Pauli operators only. Furthermore, the proof has nothing to do with the solutions of the actual atomic energy levels. Even then, stability is only found for a nuclear charge $Z \leq 6$. Thus, it is evident that neither the Schrödinger equation, variants thereof, or QED provide a general, self consistent, rigorous, and physical basis for the stability of matter.

34. E. H. Lieb, "The stability of matter", Reviews of Modern Physics, Vol. 48, No. 4, (1976), pp, 553-569.
35. L. Bugliaro, J. Fröhlich, G. M. Graf, "Stability of quantum electrodynamics with nonrelativistic matter", Physical Review Letters, Vol. 77, No. 17, (1996), pp. 3494-3497.

Section 68

Examiner Souw adds to the list of inconsistent position he has taken with the following statements on page 19 of the Appendix:

3. Regarding the alleged instability of the (excited) states

> Applicant does not adequately address the Examiner's refutation as recited in the previous Appendix, but keeps repeating and insisting the correctness of his Grand Unified Theory (GUT). Applicant misunderstands the QM by sticking to the viewpoint of classical physics, instead of properly reconciling both viewpoints under the correspondence principle. Applicant's misinterpretation of "stationary states" in QM has been adequately described previously.

Particularly troubling is the Examiner's statement that, "Applicant misunderstands the QM by sticking to the viewpoint of classical physics, instead of properly reconciling both viewpoints under the correspondence principle." The Examiner contradicts himself by stating the SQM is based on physical laws, then argues on the other side that Applicant's use of physical laws is not correct according to SQM. Rather, it is the correspondence principle (CP) that is incorrect. The basis of the CP is that physical laws do not apply to atomic-size objects, but SQM must be consistent with physical laws as the scale increases. Then, what applies in the transition, and on what scale? There are no answers to these questions under SQM, which demonstrates why that it is not a valid theory of nature.

The nonzero instantaneous velocity (the particle does move according to the Examiner) requires that the point electron of SQM must radiate, as discussed under sections dealing with the Feynman-instability argument.

What is even more troubling when considering the Examiner's insistence that the n=1 state is stationary, yet it is moving, is that the electron of zero volume would have to travel at infinite velocity and "know" how to cover all trajectories to perfectly cover the space of the wave function for n=1. Yet, to would have to do this in one period given by 13.6 eV/h, not radiate, maintain a constant energy and angular momentum, always have a relativistically invariant magnetic moment of a Bohr magneton, be electrically neutral, give rise to the Stern Gerlach result including the g factor (know to about 14 significant figures), wherein the g factor determination must be an identical value upon measurement at any time, etc. It is easy to appreciate that this view collapses on its absurdity.

Section 69

Examiner Souw errs yet again in making the following statement taken from pages 19-20 of the Appendix:

> As recited in the previous Appendix, Applicant's formulas (1.59) to (1.68), as well as Eq. (1) to (5) on pg.44-45, are mathematically flawed and physically incorrect, not only with regard to QM, but also with respect to (Maxwell's) electrodynamics and Einstein's relativity theory, as already described in the previous Appendix and in Sect. 10 below.

The Examiner's error is confirmed by other physicists, such as those who provided the reviews given in Section 54 above. The correctness of the equations and special relativistic theory is evident in the closed-formed equations having fundamental constants only that give 100's of predictions that match the experimental values with remarkable agreement. These results can not be matched by SQM. See:

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.
106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted.
102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One- Through Twenty-Electron Atoms", Physics Essays, submitted.
94. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", Physics Essays, in press.
58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.
21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

Abstracts of specific examples are:

102. **R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One- Through Twenty-Electron Atoms", Physics Essays, submitted.**

It is true that the Schrödinger equation can be solved exactly for the hydrogen atom; although, it is not true that the result is the exact solution of the hydrogen atom. Electron spin is missed entirely, and there are many internal inconsistencies and nonphysical consequences that do not agree with experimental results. The Dirac equation does not reconcile this situation. Many additional shortcomings arise such as instability to radiation, negative kinetic energy states, intractable infinities, virtual particles at every point in space, the Klein paradox, violation of Einstein causality, and "spooky" action at a distance. Despite its successes, quantum mechanics (QM) has remained mysterious to all who have encountered it. Starting with Bohr and progressing into the present, the departure from intuitive, physical reality has widened. The connection between quantum mechanics and reality is more than just a "philosophical" issue. It reveals that quantum mechanics is not a correct or complete theory of the physical world and that inescapable internal inconsistencies and incongruities arise when attempts are made to treat it as a physical as opposed to a purely mathematical "tool". Some of these issues are discussed in a review by Laloë [1]. But, QM has severe limitations even as a tool. Beyond one-electron atoms, multielectron-atom quantum mechanical equations can not be solved except by approximation methods involving adjustable-parameter theories (perturbation theory, variational methods, self-consistent field method, multi-configuration Hartree Fock method, multi-configuration parametric potential method, $1/Z$ expansion method, multi-configuration Dirac-Fock method, electron correlation terms, QED terms, etc.)—all of which contain assumptions that can not be physically tested and are not consistent with physical laws. In an attempt to provide some physical insight into atomic problems and starting with the same essential physics as Bohr of e^- moving in the Coulombic field of the proton and the wave equation as modified by Schrödinger, a classical approach was explored which yields a model which is remarkably accurate and provides insight into physics on the atomic level [2-4]. Physical laws and intuition are restored when dealing with the wave equation and quantum mechanical problems. Specifically, a theory of classical quantum mechanics (CQM) was derived from first principles that successfully applies physical laws on all scales. Rather than use the postulated Schrödinger boundary condition: "$\Psi \to 0$ as $r \to \infty$", which leads to a purely mathematical model of the electron, the constraint is based on experimental observation. Using Maxwell's equations, *the classical wave equation is solved with the constraint that the bound $n = 1$-state electron cannot radiate energy*. The electron must be extended rather than a point. On this basis with the assumption that physical laws including Maxwell's equation apply to bound electrons, the

hydrogen atom was solved exactly from first principles. The remarkable agreement across the spectrum of experimental results indicates that this is the correct model of the hydrogen atom. In this paper, the physical approach was applied to multielectron atoms that were solved exactly disproving the deep-seated view that such exact solutions can not exist according to quantum mechanics. The general solutions for one through twenty-electron atoms are given. The predictions are in remarkable agreement with the experimental values known for 400 atoms and ions.

106. **R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Foundation Louis de Broglie, submitted.**

Quantum mechanics (QM) and quantum electrodynamics (QED) are often touted as the most successful theories ever. In this paper, this claim is critically evaluated by a test of internal consistency for the ability to calculate the conjugate observables of the nature of the free electron, ionization energy, elastic electron scattering, and the excited states of the helium atom using the same solution for each of the separate experimental measurements. It is found that in some cases quantum gives good numbers, but the solutions are meaningless numbers since each has no relationship to providing an accurate physical model. Rather, the goal is to mathematically reproduce an experimental or prior theoretical number using adjustable parameters including arbitrary wave functions in computer algorithms with precision that is often much greater (e.g. 8 significant figures greater) than possible based on the propagation of errors in the measured fundamental constants implicit in the physical problem. Given the constraints of adherence to physical laws and internal consistency, an extensive literature search indicates that quantum mechanics has never solved a single physical problem correctly including the hydrogen atom and the next member of the periodic chart, the helium atom. Rather than using postulated unverifiable theories that treat atomic particles as if they were not real, physical laws are now applied to the same problem. In an attempt to provide some physical insight into atomic problems and starting with the same essential physics as Bohr of e^- moving in the Coulombic field of the proton and the wave equation as modified after Schrödinger, a classical approach is explored which yields a model which is remarkably accurate and provides insight into physics on the atomic level. The proverbial view deeply seated in the wave-particle duality notion that there is no large-scale physical counterpart to the nature of the electron is shown not to be correct. Physical laws and intuition may be restored when dealing with the wave equation and quantum atomic problems. Specifically, a theory of classical quantum mechanics (CQM) was derived from first principles as reported previously

[1-6] that successfully applies physical laws to the solution of atomic problems that has its basis in a breakthrough in the understanding of the stability of the bound electron to radiation. Rather than using the postulated Schrödinger boundary condition: "$\Psi \to 0$ as $r \to \infty$", which leads to a purely mathematical model of the electron, the constraint is based on experimental observation. Using Maxwell's equations, *the classical wave equation is solved with the constraint that the bound $n=1$-state electron cannot radiate energy.* Although it is well known that an accelerated *point* particle radiates, an *extended distribution* modeled as a superposition of accelerating charges does not have to radiate. A simple invariant physical model arises naturally wherein the predicted results are extremely straightforward and internally consistent requiring minimal math as in the case of the most famous equations of Newton, Maxwell, Einstein, de Broglie, and Planck on which the model is based. No new physics is needed; only the known physical laws based on direct observation are used. The accurate solution of the helium atom is confirmed by the agreement of predicted and observed conjugate parameters using the same unique physical model in all cases.

For examples of the successes of the relativistic theory of CQM, see Section 55 above and the paper:

107. **R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics essays, submitted.**

The claim that quantum electrodynamics (QED) is the most successful theory in history is critically evaluated. The Dirac equation was postulated in 1926 as a means to remedy the nonrelativistic nature of the Schrödinger equation to provide the missed fourth quantum number. The positive as well as negative square root terms provided an argument for the existence of negative energy states of the vacuum, virtual particles, and corresponding so-called quantum electrodynamics (QED) computer algorithms for calculating unexpected observables such as the Lamb shift and the anomalous magnetic moment of the electron. It is true that is possible to calculate to a high degree of precision the very small correction to the classical magnetic moment of a point-particle electron using QED, but it is at the expense of any reasonable or verifiable physics. The method relies on a string of far-fetched and unverifiable or disproved assumptions such as (1) infinite electric and magnetic fields that are arbitrarily normalized, (2) a "zoo" of infinite numbers of virtual particles at every point in space, (3) polarization of the vacuum by the proposed virtual particles, (4) postulated participation of the members of the zoo in myriad schemes to cause the so-called polarization, (5) the contribution from each such scheme corresponds to a coefficient based on the product of ratio of the mass of the virtual particle to that of the real

particle being experimentally observed and α/π, and (6) the schemes can be arbitrarily truncated to avoid further infinities. Due to the lack of rigor and a physical basis, QED calculations are argued to be meaningless. In a broader sense, the connection between the underlying quantum mechanics and reality is more than just a "philosophical" issue. It reveals that quantum mechanics is not a correct or complete theory of the physical world and that inescapable internal inconsistencies and incongruities arise when attempts are made to treat it as a physical as opposed to a purely mathematical "tool". Some of these issues are discussed in a review by Laloë [1]. Moreover, Dirac's original attempt to solve the bound electron physically with stability with respect to radiation according to Maxwell's equations with the further constraints that it was relativistically invariant and gives rise to electron spin is achievable using a classical approach. Starting with the same essential physics as Bohr, Schrödinger, and Dirac of e^- moving in the Coulombic field of the proton and the wave equation as modified after Schrödinger, advancements in the understanding of the stability of the bound electron to radiation is applied to solve for the exact nature of the electron. Rather than using the postulated Schrödinger boundary condition: "$\Psi \rightarrow 0$ as $r \rightarrow \infty$", which leads to a purely mathematical model of the electron, the constraint is based on experimental observation. Using Maxwell's equations, *the classical wave equation is solved with the constraint that the bound $n=1$-state electron cannot radiate energy*. Although it is well known that an accelerated *point* particle radiates, an *extended distribution* modeled as a superposition of accelerating charges does not have to radiate. A simple invariant physical model arises naturally wherein the predicted results are extremely straightforward and internally consistent requiring minimal math as in the case of the most famous equations of Newton, Maxwell, Einstein, de Broglie, and Planck on which the model is based. No new physics is needed; only the known physical laws based on direct observation are used. Rather than invoking untestable "flights of fantasy", the results of QED such as the anomalous magnetic moment of the electron, the Lamb Shift, the fine structure and hyperfine structure of the hydrogen atom, and the hyperfine structure intervals of positronium and muonium can be solved exactly from Maxwell's equations to the limit possible based on experimental measurements which confirms QED's illegitimacy as representative of reality.

Further examples of CQM results from closed-form equations containing fundamental constants only that can not be reproduced by SQM are given in attached

Tables summarizing the results of the calculated and experimental parameters of H_2, D_2, H_2^+ and D_2^+, one, two, three, four, five, six, seven, eight, nine, ten, eleven, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, and twenty-electron atoms,

the excited states of helium, the electron g factor, and relations between fundamental particles. The closed-form derivations from Maxwell's equations given in

The Grand Unified Theory of Classical Quantum Mechanics posted at http://www.blacklightpower.com/bookdownload.shtml

contain fundamental constants only. The nature of the chemical bond is given in Chp. 12. The atoms are solved exactly in Chps. 1, 7, and 10. The excited states of helium are solved exactly in Chp. 9. The electron g factor and relations between fundamental particles are given in Chp. 1 and Chps. 27 and 30, respectively.

Section 70

Examiner Souw's analysis is further flawed, as demonstrated by the following statements appearing on Appendix page 20:

> Similarly, Applicant's arguments regarding the instability of excited states based on Quantum Electrodynamics (QED) and Dirac's theory must be disqualified, since Applicant has evidently misunderstood the most basic element of the Dirac theory, specifically regarding the physical concept and the mathematics of Dirac's 4-vector, as described in more details in section 6, subparagraph (c). Therefore, Applicant's argument on this subject matter remains unpersuasive.

The Examiner's statement "regarding the physical concept" is odd. If the Examiner insists that physics must apply to the hydrogen atom, then Dirac's equation is not a valid description as discussed in the following papers:

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.
106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted.
102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One-Through Twenty-Electron Atoms", Physics Essays, submitted.
94. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", Physics Essays, in press.
80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.
58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.

21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

Specifically, the incorrectness of Dirac's equation is revealed in Applicant's paper:

107. **R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics essays, submitted.**

The claim that quantum electrodynamics (QED) is the most successful theory in history is critically evaluated. The Dirac equation was postulated in 1926 as a means to remedy the nonrelativistic nature of the Schrödinger equation to provide the missed fourth quantum number. The positive as well as negative square root terms provided an argument for the existence of negative energy states of the vacuum, virtual particles, and corresponding so-called quantum electrodynamics (QED) computer algorithms for calculating unexpected observables such as the Lamb shift and the anomalous magnetic moment of the electron. It is true that is possible to calculate to a high degree of precision the very small correction to the classical magnetic moment of a point-particle electron using QED, but it is at the expense of any reasonable or verifiable physics. The method relies on a string of far-fetched and unverifiable or disproved assumptions such as (1) infinite electric and magnetic fields that are arbitrarily normalized, (2) a "zoo" of infinite numbers of virtual particles at every point in space, (3) polarization of the vacuum by the proposed virtual particles, (4) postulated participation of the members of the zoo in myriad schemes to cause the so-called polarization, (5) the contribution from each such scheme corresponds to a coefficient based on the product of ratio of the mass of the virtual particle to that of the real particle being experimentally observed and α / π, and (6) the schemes can be arbitrarily truncated to avoid further infinities. Due to the lack of rigor and a physical basis, QED calculations are argued to be meaningless. In a broader sense, the connection between the underlying quantum mechanics and reality is more than just a "philosophical" issue. It reveals that quantum mechanics is not a correct or complete theory of the physical world and that inescapable internal inconsistencies and incongruities arise when attempts are made to treat it as a physical as opposed to a purely mathematical "tool". Some of these issues are discussed in a review by Laloë [1]. Moreover,

Dirac's original attempt to solve the bound electron physically with stability with respect to radiation according to Maxwell's equations with the further constraints that it was relativistically invariant and gives rise to electron spin is achievable using a classical approach. Starting with the same essential physics as Bohr, Schrödinger, and Dirac of e^- moving in the Coulombic field of the proton and the wave equation as modified after Schrödinger, advancements in the understanding of the stability of the bound electron to radiation is applied to solve for the exact nature of the electron. Rather than using the postulated Schrödinger boundary condition: "$\Psi \to 0$ as $r \to \infty$", which leads to a purely mathematical model of the electron, the constraint is based on experimental observation. Using Maxwell's equations, *the classical wave equation is solved with the constraint that the bound $n = 1$-state electron cannot radiate energy.* Although it is well known that an accelerated *point* particle radiates, an *extended distribution* modeled as a superposition of accelerating charges does not have to radiate. A simple invariant physical model arises naturally wherein the predicted results are extremely straightforward and internally consistent requiring minimal math as in the case of the most famous equations of Newton, Maxwell, Einstein, de Broglie, and Planck on which the model is based. No new physics is needed; only the known physical laws based on direct observation are used. Rather than invoking untestable "flights of fantasy", the results of QED such as the anomalous magnetic moment of the electron, the Lamb Shift, the fine structure and hyperfine structure of the hydrogen atom, and the hyperfine structure intervals of positronium and muonium can be solved exactly from Maxwell's equations to the limit possible based on experimental measurements which confirms QED's illegitimacy as representative of reality.

II. Quantum Electrodynamics (QED)

Quantum mechanics failed to predict the results of the Stern-Gerlach experiment which indicated the need for an additional quantum number. In quantum mechanics, the spin angular momentum of the electron is called the "intrinsic angular momentum" since no physical interpretation exists. (Currents corresponding to the observed magnetic field of the electron can not exist in one dimension of four dimensional spacetime where Ampere's law and the intrinsic special relativity determine the corresponding unique current.) The Schrödinger equation is not Lorentzian invariant in violation of special relativity. The Schrödinger equation also misses the Lamb shift, the fine structure, and the hyperfine structure completely, and it is not stable to radiation. Quantum electrodynamics was proposed by Dirac in 1926 to provide a generalization of quantum mechanics for high energies in conformity with the theory of special relativity and to provide a consistent treatment of the interaction of matter with radiation. But, it does not bridge the gap between quantum mechanics and special relativity. From Weisskopf [19], "Dirac's quantum electrodynamics gave a more consistent derivation of the results of the correspondence principle, but it also brought about a number of new and serious difficulties." Quantum electrodynamics; (1) does not explain nonradiation of bound electrons; (2) contains an internal

inconsistency with special relativity regarding the classical electron radius—the electron mass corresponding to its electric energy is infinite; (3) it admits solutions of negative rest mass and negative kinetic energy; (4) the interaction of the electron with the predicted zero-point field fluctuations leads to infinite kinetic energy and infinite electron mass; (5) Dirac used the unacceptable states of negative mass for the description of the vacuum; yet, infinities still arise. Dirac's postulated relativistic wave equation gives the inescapable result of a cosmological constant that is at least 120 orders of magnitude larger than the best observational limit due to the unacceptable states of negative mass for the description of the vacuum as discussed previously [2-7, 9-10][24]. The negative mass states further create an absolute "ether"-like frame in violation of special relativity which was disproved by the Michelson-Morley experiment.

In retrospect, Dirac's equation which was postulated to explain spin relies on the unfounded notions of negative energy states of the vacuum, virtual particles, and gamma factors; thus, it can not be the correct description of a bound electron even though it gives an addition quantum number interpreted as corresponding to the phenomenon of electron spin. Ironically, it is not even internally consistent with respect to its intent of being in accord with special relativity. In addition to violating Maxwell's equation with respect to stability to radiation wherein Maxwell's equations are implicit and the internal inconsistency with special relativity regarding the classical electron radius and states of negative rest mass and negative kinetic energy as given by Weisskopf [19], the Dirac equation violates Einstein causality and locality and conservation of energy as shown by the Klein Paradox discussed previously [2, 4, 7][25]. Furthermore, everyday observation demonstrates that causality and locality always hold. Einstein also argued that a probabilistic versus deterministic nature of atomic particles leads to disagreement with special

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[24] The Rutherford experiment demonstrated that even atoms are comprised of essentially empty space [20]. Zero-point field fluctuations, virtual particles, and states of negative energy and mass invoked to describe the vacuum are nonsensical and have no basis in reality since they have never been observed experimentally and would correspond to an essentially infinite cosmological constant throughout the entire universe including regions of no mass. As given by Waldrop [21], "What makes this problem into something more than metaphysics is that the cosmological constant is observationally zero to a very high degree of accuracy. And yet, ordinary quantum field theory predicts that it ought to be enormous, about 120 orders of magnitude larger than the best observational limit. Moreover, this prediction is almost inescapable because it is a straightforward application of the uncertainty principle, which in this case states that every quantum field contains a certain, irreducible amount of energy even in empty space. Electrons, photons, quarks—the quantum field of every particle contributes. And that energy is exactly equivalent to the kind of pressure described by the cosmological constant. The cosmological constant has accordingly been an embarrassment and a frustration to every physicist who has ever grappled with it."

[25] Oskar Klein pointed out a glaring paradox implied by the Dirac equation which was never resolved [23]. "Electrons may penetrate an electrostatic barrier even when their kinetic energy, $E - mc^2$ is lower than the barrier. Since in Klein's example the barrier was infinitely broad this could not be associated with wave mechanical tunnel effect. It is truly a paradox: Electrons too slow to surpass the potential, may still only be partially reflected. ...Even for an infinitely high barrier, i.e. $r_2 = 1$ and energies $\approx 1\ MeV$, (the reflection coefficient) R is less than 75%! From (2) and (3) it appears that as soon as the barrier is sufficiently high: $V > 2mc^2$, electrons may transgress the repulsive wall—seemingly defying conservation of energy. ...Nor is it possible by way of the positive energy spectrum of the free electron to achieve complete Einstein causality."

relativity. In fact, the nonlocality result of the Copenhagen interpretation violates causality as shown by Einstein, Podolsky, and Rosen (EPR) in a classic paper [22] that presented a paradox involving instantaneous (faster-than-light) communication between particles called "spooky action at a distance" which led them to conclude that quantum mechanics is not a complete or correct theory. The implications of the EPR paper and the exact Maxwellian predictions of "spooky action" and "entanglement" experiments, incorrectly interpreted in the context of quantum mechanic, are given in Chp. 37 of Ref. [7].

In 1947, contrary to Dirac's predictions, Lamb discovered a $1000\ MHz$ shift between the ${}^2S_{1/2}$ state and the ${}^2P_{1/2}$ state of the hydrogen atom [24]. This so called Lamb Shift marked the beginning of modern quantum electrodynamics. In the words of Dirac [25], "No progress was made for 20 years. Then a development came initiated by Lamb's discovery and explanation of the Lamb Shift, which fundamentally changed the character of theoretical physics. It involved setting up rules for discarding ...infinities..." Renormalization is presently believed to be required of any fundamental theory of physics [26]. However, dissatisfaction with renormalization has been expressed at various times by many physicists including Dirac [27] who felt that, "This is just not sensible mathematics. Sensible mathematics involves neglecting a quantity when it turns out to be small—not neglecting it just because it is infinitely great and you do not want it!"

Albeit, the Dirac equation did not predict the Lamb shift or the electron g factor [24, 28-29], its feature of negative-mass states of the vacuum gave rise to the postulates of QED that has become a center piece of quantum mechanics to explain these and other similar observations. One of QED's seminal aspects of renormalization which was subsequently grafted into atomic theory was a turning point in physics similar to the decision to treat the electron as a point-particle-probability wave, a point with no volume with a vague probability wave requiring that the electron have an infinite number of positions and energies including negative and infinite energies simultaneously. The adoption of the probabilistic versus deterministic nature of atomic particles violates all physical laws including special relativity with violation of causality as pointed out by Einstein [22] and de Broglie [30]. Consequently, it was rejected even by Schrödinger [31].

Pure mathematics took the place of physics when calculating subtle shifts of the hydrogen atomic energy levels. Moreover, in QED, the pure mathematics approach has been confused with physics to the point that virtual particles are really considered as causing the observable. The justification for the linkage is often incorrectly associated with the usage of series expansion and variational methods to solve problems based on physical laws. But, series expansion of an equation based on a physical action or variation of a physical parameter of the equation versus the fabrication of an action based on fantastical untestable constructs that are represented by a series are clearly different. For example, the motion of a pendulum can be solved exactly in terms of an elliptic integral using Newtonian mechanics. Expansion of the elliptic integral in a power series

and ignoring negligible terms in the series versus setting up of arbitrary rules for *discarding infinities* are clearly not the same. Furthermore, inventing virtual particles that have an action on space, and subsequently on an electron, versus expanding terms in the energy equation due to a gravitating body causing a gravitational field and thus an action on the pendulum are very different. In QED, virtual particles are not merely a sustitutional or expansion variable. They are really considered as causing the observable.

In a further exercise of poor science, virtual-particle-based calculations are even included in the determination of the fundamental constants which are circularly used to calculate the parameter ascribed to the virtual particles. For example, using the electron magnetic moment anomaly in the selection of the best value of the fine structure constant, the CODATA publication [32] reports the use of virtual particles:

> "The term A1 is mass independent and the other terms are functions of the indicted mass ratios. For these terms the lepton in the numerator of the mass ratio is the particle under consideration, while the lepton in the denominator of the ratio is the virtual particle that is the source of vacuum polarization that gives rise to the term."

There is no direct evidence that virtual particles exist or that they polarize the vacuum. Even their postulation is an oxymoron.

Throughout the history of quantum theory, wherever there was an advance to a new application, it was necessary to repeat a trial-and -error experimentation to find which method of calculation gave the right answers. Often the textbooks present only the successful procedure as if it followed from first principles and do not mention the actual method by which it was found. In electromagnetic theory based on Maxwell's equations, one deduces the computational algorithm from the general principles. In quantum theory, the logic is just the opposite. One chooses the principle (e.g. phenomenological Hamiltonians) to fit the empirically successful algorithm. For example, we know that it required a great deal of art and tact over decades of effort to get correct predictions out of QED. The QED method of the determination of $(g-2)/2$ from the *postulated* Dirac equation is based on a *postulated* power series of α/π where each *postulated* virtual particle is a source of *postulated* vacuum polarization that gives rise to a *postulated* term which is processed over decades using ad hoc rules to remove infinities from each term that arises from *postulated* scores of *postulated* Feynman diagrams. The solution so obtained using the perturbation series further requires a *postulated* truncation since the series *diverges*. Mohr and Taylor reference some of the Herculean efforts to arrive at g using QED [32]:

> "the sixth-order coefficient $A_1^{(6)}$ arises from 72 diagrams and is also known analytically after nearly 30 years of effort by many researchers [see Roskies, Remiddi, and Levine (1990) for a review of the early work]. It was not until 1996 that the last remaining distinct diagrams were calculated analytically, thereby completing the theoretical expression for $A_1^{(6)}$".

For the right experimental numbers to emerge, one must do the calculation (i.e. subtract off the infinities) in one particular way and not in some other way that appears in principle equally valid. For example, Milonni [33] presents a QED derivation of the magnetic moment of the electron which gives a result of the wrong sign and requires the introduction of an

> "upper limit K in the integration over $k = \omega / c$ in order to avoid a divergence."

A differential mass is arbitrarily added, then

> "the choice $K = 0.42mc/\hbar$ yields $(g-2)/2 = \alpha / 2\pi$ which is the relativistic QED result to first order in α. [...] However, the reader is warned not to take these calculations too seriously, for the result $(g-2)/2 = \alpha / 2\pi$ could be obtained by retaining only the first (radiation reaction) term in (3.112) and choosing $K = 3mc/8\hbar$. It should also be noted that the solution $K \cong 0.42mc/\hbar$ of (3.112) with $(g-2)/2 = \alpha / 2\pi$ is not unique."

Such an ad hoc nonphysical approach makes incredulous:

> " the cliché that QED is the best theory we have!" [34]

or the statement that:

> "The history of quantum electrodynamics (QED) has been one of unblemished triumph" [35].

There is a corollary, noted by Kallen: from an inconsistent theory, any result may be derived.

In an attempt to provide some physical insight into atomic problems and starting with the same essential physics as Bohr of e^- moving in the Coulombic field of the proton and the wave equation as modified after Schrödinger, a classical approach was explored which yields a model which is remarkably accurate and provides insight into physics on the atomic level [2-7]. Physical laws and intuition are restored when dealing with the wave equation and quantum mechanical problems. Specifically, a theory of classical quantum mechanics (CQM) was derived from first principles that successfully applies physical laws on all scales. Rather than use the postulated Schrödinger boundary condition: "$\Psi \to 0$ as $r \to \infty$", which leads to a purely mathematical model of the electron, the constraint is based on experimental observation. Using Maxwell's equations, *the classical wave equation is solved with the constraint that the bound $n = 1$-state electron cannot radiate energy*. The electron must be extended rather than a point. On this basis with the assumption that physical laws including Maxwell's equation apply to bound electrons, the hydrogen atom was solved exactly from first principles. The remarkable agreement across the spectrum of experimental results indicates that this is the correct model of the hydrogen atom.

It was shown previously that quantum mechanics does not explain the stability of the atom to radiation [2]; whereas, the Maxwellian approach gives a natural relationship between Maxwell's equations, special relativity, and general relativity. CQM holds over a scale of spacetime of 85 orders of magnitude—it correctly predicts the nature of the universe from the scale of the quarks to that of the cosmos [3]. A review is given by Landvogt [36]. In a

third paper, the atomic physical approach was applied to multielectron atoms that were solved exactly disproving the deep-seated view that such exact solutions can not exist according to quantum mechanics. The general solutions for one through twenty-electron atoms are given in Ref [4]. The predictions are in remarkable agreement with the experimental values known for 400 atoms and ions. A fourth paper presents a solution based on physical laws and fully compliant with Maxwell's equations that solves the 26 parameters of molecular ions and molecules of hydrogen isotopes in closed-form equations with fundamental constants only that match the experimental values [5]. In a fifth paper, the nature of atomic physics being correctly represented by quantum mechanics versus classical quantum mechanics is subjected to a test of internal consistency for the ability to calculate the conjugate observables using the same solution for each of the separate experimental measurements [6]. It is confirmed that the CQM solution is the accurate model of the helium atom by the agreement of predicted and observed conjugate parameters of the free electron, ionization energy of helium and all two electron atoms, ionization energies of multielectron atoms, electron scattering of helium for all angles, and all He I excited states using the same unique physical model in all cases. Over five hundred conjugate parameters are calculated using a unique solution of the two-electron atom without any adjustable parameters to achieve overall agreement to the level obtainable considering the error in the measurements and the fundamental constants in the closed-form equations.

In contrast, the quantum fails utterly. Ad hoc computer algorithms are used to generate meaningless numbers with internally inconsistent and nonphysical models that have no relationship to physics. Attempts are often made to numerically reproduce prior theoretical numbers using adjustable parameters including arbitrary wave functions in computer programs with precision that is often much greater (e.g. 8 significant figures greater) than possible based on the propagation of errors in the measured fundamental constants implicit in the physical problem.

In this sixth paper of a series, rather than invoking renormalization, untestable virtual particles, and polarization of the vacuum by the virtual particles, the results of QED such as the anomalous magnetic moment of the electron, the Lamb Shift, the fine structure and hyperfine structure of the hydrogen atom, and the hyperfine structure intervals of positronium and muonium (thought to be only solvable using QED) are solved exactly from Maxwell's equations to the limit possible based on experimental measurements.

Section 71

Other aspects of Examiner Souw's analysis also prove to be nonsensical, such as the following discussion on Appendix page 20:

4. Regarding "Applicant misunderstands the most basic fundamentals of the QM theory"

(a) Applicant's attempt to argue that Applicant's electron wave function p(r,t) involving ä-function does not need to satisfy --or must not be a solution of-- the wave equation (pg.45) is totally unacceptable, and hence, unpersuasive because applicant's response contradicts the mathematical requirement that any valid solution must satisfy the generic equation.

The Examiner's comment about Applicant's argument being "unpersuasive because applicant's response contradicts the mathematical requirement that any valid solution must satisfy the generic equation" is not well taken. On which physical law is this statement by the Examiner based? In fact, radial motion in an inverse-squared field according to SQM violates stability and conservation of energy, as pointed out in Section 63 above.

Section 72

On Appendix page 20, Examiner Souw further argues, inconsistently, that:

> Applicant's insistence that his ä-function-based "solution" p(r,t) does not need to satisfy --or must not be a solution of-- the wave equation, violates the basic laws of physics and mathematics. It must be emphasized that the entire physics and mathematics that have been developed since Newton and Leibniz form together a non-self-contradictory entity generally accepted by the scientific community. It is a high barrier to disprove what is accepted by conventional science, such as QM (Quantum Mechanics).

Regarding the false assertion that Applicant's position "violates the basic laws of physics and mathematics," the Examiner offers no law of nature that requires this to be true. In fact, it is not even internally consistent with SQM' s rigid-rotor equation [McQuarrie, D. A., *Quantum Chemistry*, University Science Books, Mill Valley, CA, (1983), pp. 206-225]. See Section 63 above.

Section 73

Examiner Souw is also flat out wrong in his statement on page 21 of the Appendix that:

> Since Applicant's GUT is entirely based on this ä-function-based electron wave function p(r,t) which is not a solution of his own starting wave equation, Applicant's flawed GUT does not provide any theoretical support to this patent application. Any further attempt to argue the patentability of his application by relying on GUT will be dismissed as UNPERSUASIVE with referral to this section, ***II.4.a.***.

This is not true at all. As shown in Section 63 above and GUT Chp. 1 [Ref. #1], the condition of nonradiation requires that the three-dimensional wave equation plus time be reduced to the two-dimensional wave equation plus time. This equation IS rigorously solved for 100's of observables with remarkable agreement between predicted and experimental values. The results are absolutely predictive in that the same solution for the electron is used in all of the 100's of predictions. There is not a single example in SQM where this is the case. Others agree with Applicant as indicated in Section 54 above. The Examiner's refusal to acknowledge these facts is telling.

Section 74

Examiner Souw continues his flawed analysis by stating on Appendix page 21:

> (b) Applicant's angular momentum wave functions (instead of eigenfunctions), as derived in GUT and partly reproduced on pg.58-64, are mathematically flawed and in direct violation of the conventional QM, as already described in the previous Appendix. It turns out, Applicant's rejection of QM is solely caused by Applicant's misunderstanding and misinterpretation of the QM, the latter having been acknowledged in the art as being the most successful theory in the whole history of physics. The validity of QM has been quantitatively verified by multiple generations of physicists/scientists and by thousands, if not millions of phenomena and effects encountered in science and technology.

The angular functions are charge-density waves that describe real charge moving in space and time. They do not refer to the weird probability-density functions of quantum mechanics that are nonphysical. The CMQ results match the data exactly. In contrast, the SQM result has many problems in this regard regarding infinities and nondegeneracy in the absence of a magnetic field as reported in the literature previously:

80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

The hype associated with standard quantum mechanics is incredible, especially given that it has never solved a single problem using physical laws with internal consistency and comprises nonphysical computer curve-fitting algorithms. It is not predictive since there is not a single example where a SQM result can be used to predict another, even known result. Some of the hype is discussed in Section 70 above.

The made-up procedures and ad hoc curve fitting approaches discussed in Section 70, Appendix II of Mills GUT (Ref. #1), and paper #107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted, make these types of statements incredulous. SQM can not match the closed-form results given in the QED paper (#107) and Mills GUT, some of which are summarized in Sections 55 and 69 above.

Section 75

Examiner Souw repeats prior erroneous statements on page 21 of the Appendix, wherein he claims:

> In contrast, applicant's flawed "theory" has not been verified even by a single experiment conducted by an independent third party to date. Thus, Applicant's argument regarding alleged flaws in QM is unpersuasive.

CQM unifies Maxwell's equations, special, and general relativity with atomic physics. It predicts gravitation from fundamental particles and predicts their masses. It

gives closed-form equations with fundamental constants only for the masses and the evolution of the cosmos as a function of time. Applicant's theory correctly predicted by mass of the top quark before it was detected on the D0 detector. It also correctly predicted the acceleration of the expansion of the universe before it was detected to the shock of cosmology experts.

CQM also predicted the existence of hydrinos before experiments were run. In addition to the results given in Applicant's 112 experiments, independent researchers have also conformed this prediction of CQM, as summarized in the 51 reports and papers given in the section entitled "Independent Test Results". Since SQM is not predictive, it is not surprising that it did not and can not predict any of these discoveries. For example, the ratios of the masses of fundamental particles that can not be reproduced by SQM are:

RELATIONS BETWEEN FUNDAMENTAL PARTICLES

The relations between the lepton masses and neutron to electron mass ratio which are independent of the definition of the imaginary time ruler ti including the contribution of the fields due to charge production are given in terms of the dimensionless fine structure constant α only:

$$\frac{m_\mu}{m_e} = \left(\frac{\alpha^{-2}}{2\pi}\right)^{\frac{2}{3}} \frac{\left(1+2\pi\frac{\alpha^2}{2}\right)}{\left(1+\frac{\alpha}{2}\right)} = 206.76828 \qquad (206.76827)^{a}$$

$$\frac{m_\tau}{m_\mu} = \left(\frac{\alpha^{-1}}{2}\right)^{\frac{2}{3}} \frac{\left(1+\frac{\alpha}{2}\right)}{\left(1-4\pi\alpha^2\right)} = 16.817 \qquad (16.817)$$

$$\frac{m_\tau}{m_e} = \left(\frac{\alpha^{-3}}{4\pi}\right)^{\frac{2}{3}} \frac{\left(1+2\pi\frac{\alpha^2}{2}\right)}{\left(1-4\pi\alpha^2\right)} = 3477.2 \qquad (3477.3)$$

$$\frac{m_N}{m_e} = \frac{12\pi^2}{1-\alpha}\sqrt{\frac{\sqrt{3}}{\alpha}} \frac{\left(1+2\pi\frac{\alpha^2}{2}\right)}{\left(1-2\pi\frac{\alpha^2}{2}\right)} = 1838.67 \qquad (1838.68)$$

[a] Experimental according to the 1998 CODATA and the Particle Data Group [K. Hagiwara et al., Phys. Rev. D 66, 010001 (2002); http://pdg.lbl.gov/2002/s035.pdf; P. J. Mohr and B. N. Taylor, "CODATA recommended values of the fundamental physical constants: 1998", Reviews of Modern Physics, Vol. 72, No. 2, April, (2000), pp. 351-495].

The agreement between the experimental and observed values is truly remarkable, as is the Examiner's failure to recognize this astonishing accomplishment.

Section 76

Examiner Souw further argues on page 21 of the Appendix that:

(c) Applicant's remark, *"there is no a priori basis for any theory to be correct"*, does not contradict the Examiner's view. However, there are plenty of a priori basis for a theory to be incorrect, e.g., if the theory is incredible, illogical and/or self-contradictory, such as Applicant's GUT and hydrino theory.

Since SQM predicts infinities in the electron's electric and magnetic fields and they are not observed, it is proven wrong. Since SQM predicts that the electron in the n=1 state has instantaneous acceleration, it must radiate. Since radiation is not observed, again, it is proven wrong. Since the angular solutions that are square-integrable predict large nondegeneracy in the orbital angular momenta and energies and these are not observed, it is further proven wrong. Since SQM predicts the electron can move radially from the nucleus (and even be inside the nucleus) violating conservation of energy and angular momentum and such violation is not observed, SQM is proven wrong yet again. The list goes on and on.

See:

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.
106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted.
102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One-Through Twenty-Electron Atoms", Physics Essays, submitted.
94. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", Physics Essays, in press.

80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.
58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.
21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

In contrast Applicant's CQM is based on Maxwell's equation and special and general relativity. These physical laws have never been proven wrong, and now Applicant has shown how to solve them on the level of the atom with stunningly accurate results.

Section 77

Examiner Souw argues on pages 21-22 of his Appendix that:

> The Examiner's view on Applicant's theory and experimental evidence is totally different than Applicant's: (a) A correct scientific theory must be mathematically and conceptually self-consistent, and should not contain self-contradiction, e.g., mathematical flaws. In this regard, Applicant's entire theory, as documented in the GUT document, contains an unprecedented amount of mathematical flaws and errors, as already demonstrated in the previous Appendixes included in all the office actions of record, some of which are now repeated, confirmed and emphasized.

The Examiner has it backwards. These deficiencies rest with SQM, not CQM, as discussed in the prior theory sections of this Response.

Section 78

The Examiner asserts on page 22 of his Appendix that:

(b) A correct scientific concept must be proven by experimental evidence. In this regard, NONE of Applicant's "experimental evidence" is scientifically valid, as already discussed by the Primary Examiner(s) in his/her main Office Action. Applicant's alleged "evidence" falls into three categories, which have been discussed in Part I and already presented in the previous Appendix.

This redundant issue has already been dismissed in the Experimental sections of this Response.

Section 79

Examiner Souw also wrongly argues on Appendix page 22 that:

5. Regarding Applicant's misunderstanding of Haus's non-radiative condition

(a) On pg. 51/lines 4-5, Applicant recites: *"a time dependent charge corresponds to a current"*. This is just one of the unprecedented number of mathematical flaws and misunderstanding of elementary physical concepts in Applicant's GUT. The mathematical flaw lies in the fact that a current ***J*** is a vector quantity (or field), whereas p(***r***,t) is a scalar, so they can never be the same as claimed by Applicant (J??/ñ?t, since the left hand side is a vector and the right hand side is a scalar). The physical flaw lies in the fact that they are fundamentally of different natures. Only together (hence their different natures!) they form the charge conservation law, i.e., by virtue of the well known formula ***div·J***+?ñ/?t =0 (note the scalar operation ***div·*** on vector ***J***; not ***J*** itself). The GUT is completely silence on such mathematical relation and/or operation. Hence, any hindsight argument in this direction from Applicant's side inevitably would be automatically considered invalid and unpersuasive.

Regarding the Examiner's argument based on "the fact that a current ***J*** is a vector quantity (or field), whereas p(***r***,t) is a scalar," Applicant points out that he correctly considered the vector aspect of the current. In the paper 58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press, appears:

The current due to the time dependent term is

$$
\begin{aligned}
\mathbf{J} &= \frac{\omega_n}{2\pi}\frac{e}{4\pi r_n^2} N[\delta(r-r_n)]\mathrm{Re}\{Y_\ell^m(\theta,\phi)\}[\mathbf{u}(t)\times\mathbf{r}] \\
&= \frac{\omega_n}{2\pi}\frac{e}{4\pi r_n^2} N[\delta(r-r_n)]\mathrm{Re}\{Y_\ell^m(\theta,\phi)e^{i\omega_n t}\}[\mathbf{u}\times\mathbf{r}] \\
&= \frac{\omega_n}{2\pi}\frac{e}{4\pi r_n^2} N'[\delta(r-r_n)]\mathrm{Re}\left(P_\ell^m(\cos\theta)e^{im\phi}e^{i\omega_n' t}\right)[\mathbf{u}\times\mathbf{r}] \\
&= \frac{\omega_n}{2\pi}\frac{e}{4\pi r_n^2} N'[\delta(r-r_n)]\left(P_\ell^m(\cos\theta)\cos\left(m\phi+\omega_n' t\right)\right)[\mathbf{u}\times\mathbf{r}] \\
&= \frac{\omega_n}{2\pi}\frac{e}{4\pi r_n^2} N'[\delta(r-r_n)]\left(P_\ell^m(\cos\theta)\cos\left(m\phi+\omega_n' t\right)\right)\sin\theta\hat{\phi}
\end{aligned}
\tag{21}
$$

where to keep the form of the spherical harmonic as a traveling wave about the z-axis, $\omega_n' = m\omega_n$ and N and N' are normalization constants. The vectors are defined as

$$\hat{\phi} = \frac{\hat{u}\times\hat{r}}{|\hat{u}\times\hat{r}|} = \frac{\hat{u}\times\hat{r}}{\sin\theta}; \qquad \hat{u} = \hat{z} = orbital\ axis \tag{22}$$

$$\hat{\theta} = \hat{\phi}\times\hat{r} \tag{23}$$

"^" denotes the unit vectors $\hat{u} \equiv \frac{\mathbf{u}}{|\mathbf{u}|}$, non-unit vectors are designed in bold, and the current function is normalized.

<u>Section 80</u>

Examiner Souw further argues on page 23 of his Appendix that:

(b) In GUT, as well as on pg. 51/ff of 83, Applicant's Eqs. 1-39 through 1.45 are mathematically flawed, as already recited in the previous Appendix, sect.4/pg.3/lines 8-12 and pg.4/lines 9. One of ordinary skill in the art can easily show that Applicant's charge density p(***r***,t) is <u>neither</u> a solution of the Maxwell/Helmholtz equation in terms of Laplace operator <u>nor</u> the Schrödinger equation, i.e., by virtue of the fully analytical integral representation of the ä-function that can be mathematically treated in a rigorous manner (see original Appendix, section 4). Not only is this <u>another</u> example out of an unprecedented number of mathematical flaws and misunderstanding of elementary physical concepts in Applicant's GUT, but most importantly, a solid proof that Applicant's derivation of the hydrino theory is based on the failure to apply rigorous mathematics as proofs as every physics theory should be based upon

Applicant's charge density functions are solutions of the two-dimensional wave equation plus time, as discussed above in Sections 63 and 73 above. These solutions are well known as given in Chp I of Mills GUT and McQuarrie, D. A., *Quantum*

Chemistry, University Science Books, Mill Valley, CA, (1983), pp. 206-225. They satisfy the constraint of nonradiation according to Maxwell's equation as shown in the following peer-reviewed paper:

58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.

and in Chp 1 and Appendix I of Mills GUT. They are unprecedented in their success at predicting experimental observables as discussed in previous sections, including Sections 54-55 and 69-70.

<u>Section 81</u>

Examiner Souw further argues on page 23 of the Appendix that:

> (c) Applicant's Eq. 1.41 to 1.45 are based on an incorrect application -- and is a result of his serious misunderstanding-- of the Special Relativity Theory, specifically regarding the inapplicability of the theory to a circulating electron, as already described in previous Appendix. Applicant has failed to address the Examiner's refutation and show a proper understanding of the Relativity Theory in his response to the Examiner's Appendix (see also last section 10).

Applicant's theory is the most successful to date at applying special relativity to the atom, as shown in Section 55 of this Response. SQM can not match these results and is incompatible with special relativity as shown in:

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.
80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.

SQM lacks Einstein causality and even resurrects the disproved ether. Since the electron motion can not be defined, it is impossible to apply special relativity to SQM, which indicates a huge failure. However, another problem arises by correcting the mass while maintaining the invariance of charge under special relativity. The mass to charge ratio is then not invariant; thus, the Bohr magneton of magnetic moment is not invariant. Since experimentally it is invariant, SQM is disproved in yet another instance.

Furthermore, in additional refutation of past rejections by the Examiner: The electron moves in an orbit relative to the laboratory frame. Muons and electrons are both leptons. Time dilation of muonic decay due to relativistic motion in a cyclotron orbit relative to a stationary laboratory frame provides strong confirmation of special relativity and confirms that the electron's frame is an inertial frame. eB/m bunching of electrons in a gyrotron [P. Sprangle and A. T. Drobot, "The linear and self-consistent nonlinear theory of the electron cyclotron maser instability", IEEE Transactions on Microwave Theory and Techniques, Vol. MTT-25, No. 6, June, (1977), pp. 528-544] occurs because the cyclotron frequency is inversely proportional to the relativistic electron mass. This further demonstrates that the electron frame is an inertial frame and that electron mass and time dilation occur. The special relativistic relationship in polar coordinates is derived. The result of the treatment of the electron motion relative to the laboratory frame is in excellent agreement with numerous experimental observables such as the electron g factor, the invariance of the electron magnetic moment of μ_B and angular momentum of $\hbar$, the fine structure of the hydrogen atom, and the relativistically corrected ionization energies of one and two electron atoms given in:

102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One-Through Twenty-Electron Atoms", Physics Essays, submitted
107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.
106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted.

and in the Excited States of the One-Electron Atom (Quantization) and The Two-Electron Atom sections of Mills GUT.

Section 82

On pages 23-24 of the Souw Appendix, the Examiner further argues:

(d) Applicant's statement on pg.55 that, "[t]he distinction between an eigenfunction and a wavefunction comprised of eigenfunctions is due entirely to a mathematical postulate of QM", is mathematically incorrect:

Per definition, eigenfunctions are solutions of an eigenvalue equation. Not only the Schrödinger Equation (SE), but also the electromagnetic wave equation of Helmholtz are eigenvalue equations. Consequently, the monochromatic wave function exp i(kx-ùt) is an eigenfunction solution of the wave equation, and a wave packet can be constructed as a superposition of such eigenfunctions. Applicant's GUT theory is based on applicant's serious misunderstanding in this crucial subject matter.

What is there to be confused about? Applicant understands that the basic function sinwt is an eigenfunction; others may be more complicated, but the distinguishing feature is that the derivative is a constant times the function.

Applicant made the point in a prior Action that a sum of eigenfunctions is an eigenfunction. It is irrelevant that SQM requires that the eigenfunctions be square integrable, which is the original argument that the Examiner is diverting from. He admits that linear combinations of eigenfunctions do not work in SQM since SQM is not a theory based on physics. It is nonsensical to square a probability-wave function to get a charge or mass function. In CQM the electron states comprise the sum of a constant charge-density function corresponding to spin angular momentum and a spherically- and time-harmonic function that modulates the constant function and corresponds to orbital angular momentum. This eliminates the failures of SQM in providing a current corresponding to spin, the lack of degenerate orbital angular levels in the absence of a magnetic field, and other failings as reported previously in the literature:

17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

Section 83

Examiner Souw continues his flawed analysis by arguing on page 24 of his Appendix that:

> **6. Applicant's confusion regarding wavefunction and eigenfunction**
>
> (a) Due to applicant's misunderstanding of eigenfunctions (see above), applicant then proceeds to separate the physics of angular momentum from its mathematics (e.g., on pg.54-55, and once again on pg.64). A most important characteristic of modern science (ever since Newton) is, that physics must be quantitatively expressed in rigorous mathematics (besides it must be also experimentally verifiable, independent of time, location and observer). The mathematical basis for the QM concept, including the complementary property of position and momentum as well as the Heisenberg uncertainty principle (HUP), is the Fourier Transform, in which both the HLJP as well as the concept of eigenfunctions, as distinguished from a superposition (wavepacket), can be intuitively grasped by one of ordinary skill in the art.

Actually it is SQM that is not correct according to physical laws, and CQM does not suffer from these flaws as discussed in Sections 73, 80, and 82 above. The Examiner is correct that Applicant does not solve for a probability-density function that is square-integrable as in the case of SQM. Applicant has shown that this is not correct in that it leads to disagreement between predictions and experiments that do not occur in the case of CQM. The fact that SQM relies on such a probability-wave construct requires that it is implicitly in violation of physical laws as shown in:

80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.
21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey,

Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

It is further trivially appreciated that mass and charge add linearly, not as the square of the sum.

Applicant admits that he has no idea what the Examiner is saying with the following string of seeming flights of fantasy:

> The mathematical basis for the QM concept, including the complementary property of position and momentum as well as the Heisenberg uncertainty principle (HUP), is the Fourier Transform, in which both the HUP as well as the concept of eigenfunctions, as distinguished from a superposition (wavepacket), can <u>be intuitively grasped</u> by <u>one of ordinary skill in the art.</u>

This speak is not found in any classical physics book that Applicant is aware of. Where in the literature is the Fourier Transform taken on the HUP for example, and what is its physical significance? In any event, Applicant's theory is intuitive and derived from physical laws so no such esoteric utterances arise.

Section 84

Examiner Souw further argues on pages 24-25 of his Appendix that:

(b) On pg.55/lines 8-10 from bottom, Applicant's statement regarding the <u>impossibility of zero rotational energy</u> in case of zero angular momentum (L=0) has no basis whatsoever, and hence, is here dismissed and disregarded. For L=0, the wavefunction is known to be spherical symmetric, meaning that the electron is everywhere within 0? (è,ö)?2∂ with <u>equal probability</u>. To "see" an electron density probability that is inhomogeneous over the angle coordinates (è,ö), a superposition of angular momenta eigenfunctions is necessary, as described in the original Appendix, which also means that äL>0 and the system is no longer spherical-symmetric. A spherical-symmetric system (L=0) has a zero angular momentum, since $\boldsymbol{L}^2 \boldsymbol{Y}_{L.m1}$(è,ö) =0 for **L**=0, and $\boldsymbol{L}\mathrm{Y}_{\mathrm{O,O}}$(è,ö)= ***(r*** x ***p)***$\mathrm{Y}_{\mathrm{O,O}}$(è,ö) <u>with ***p*** being a differential operator</u> (defined by McQuarrie [1] Eqs.6-81 & 6-83), is also identical to zero, since $\mathrm{Y}_{\mathrm{O,O}}$(è,ö) is a <u>constant</u> (see previous Appendix pg.5-6). Consequently, the rotational energy, $\mathrm{E_R}$=L(L+1)_^{2}/2I (McQuarrie [1] Eq.6-61/pg.219), is also zero for L=0, whereas $\mathrm{E_R}$= _^{2}/I for L=1, in direct contradiction to Applicant's claim that the lowest rotational energy is $\mathrm{E_R}$=_^{2}/2mr^2, as recited on pg.55 lines 24-25. Applicant has obviously misunderstood his own cited reference McQuarrie [1], i.e., by inserting L=1 (but not

L=0) and $I=mr^2$ in Eq.6-61 on pg. 219 and 209, where r is there NOT the radius of hydrogen atom as Applicant would like to mean, but (r is) the inter-atomic distance in a diatomic molecule, whereas Applicant's m, or McQuarrie's ì., is its reduced mass, as recited in [1] on pg.212/Example 6-5. It is also clear that L=0 is inclusive in the complete set, as recited in Eq.6-60 in [1] on pg.209. McQuarrie [1] discusses in §6-5 to §6-7 the Rigid Rotator model, unambiguously reciting in the title of §6-5 that the Rigid Rotator is a Model for a Rotating Diatomic Molecule ([1}/pgs.210-221).

The Examiner admits that in SQM, the electron has no angular momentum, which is impossible for the case of any physical object bound by an inverse-squared force law, as shown in any basic mechanics book such as

G. R. Fowles, Analytical Mechanics, Third Edition, Holt, Rinehart, and Winston, New York, (1977), pp. 145-158.

Thus, the **Examiner has admitted that SQM does not agree with physical laws**.

Regarding Examiner Souw's comments regarding the "contradiction to Applicant's claim that the lowest rotational energy is $E_R=\_^2/2mr^2$, as recited on pg.55 lines 24-25," Applicant notes that, in CQM, the orbital angular momentum is zero for L=0, and the spin angular momentum is not zero as it must be and is given in Chp 1 of Mills GUT:

The z-axis projection of the spin angular momentum was derived in the Spin Angular Momentum of the Orbitsphere with ℓ = 0 section.

$$L_z = I\omega\mathbf{i}_z = \pm\frac{\hbar}{2} \tag{1.78}$$

where ω □is given by Eq. (1.55); so,

ℓ = 0

$$|L_z| = I\frac{\hbar}{m_e r^2} = \frac{\hbar}{2} \tag{1.79}$$

Thus,

$$I_z = I_{spin} = \frac{m_e r_n^2}{2} \tag{1.80}$$

From Eq. (1.51),

$$E_{rotational\ spin} = \frac{1}{2}\left[I_{spin}\omega^2\right] \tag{1.81}$$

From Eqs. (1.55) and (1.80),

$$E_{rotational} = E_{rotational\ \ spin} = \frac{1}{2}\left[I_{spin}\left(\frac{\hbar}{m_e r_n^2}\right)^2\right] = \frac{1}{2}\left[\frac{m_e r_n^2}{2}\left(\frac{\hbar}{m_e r_n^2}\right)^2\right] = \frac{1}{4}\left[\frac{\hbar^2}{2I_{spin}}\right] \quad (1.82)$$

When $\ell \neq 0$, the spherical harmonic is not a constant and the charge-density function is not uniform over the orbitsphere. Thus, the angular momentum can be thought of arising from a spin component and an orbital component.

The Examiner's mistakenly argues McQuarrie's rigid rotor problem, which does not apply for l=0.

<u>Section 85</u>

Examiner Souw continues his erroneous analysis by stating on page 25 of the Appendix that:

> Hydrogen atom is handled by McQuarrie [1] in §6-8 on pg.221 ff. As stated by McQuarrie [1] on pgs.222-223, Eqs. 6-99 & 6-100, the energy of a hydrogen electron for different quantum numbers (n,L,m) in the absence of magnetic field is <u>degenerate in (L,m)</u>, as recited on pg.225, line 20-22 of § 6-9, i.e., it depends only on the principal quantum n, with L satisfying 0=L=n-1 (Eq.6-101 in [1]/pg.223), i.e., <u>L=0 also inclusive</u>. Obviously, Applicant's has misunderstood the zero angular momentum case in his own cited reference, McQuarrie [1], for misinterpreting $Y_{0,0}$ as being a spin eigenfunction (GUT, Eqs.1.61-1.65) based on his erroneous understanding that L=0, or zero rotational energy, is impossible, as recited by Applicant on (pg.55, lines 24-25).

First of all, it is impossible to have zero rotational energy for a moving bound electron. Furthermore, despite what is says in McQuarrie [1], SQM has it wrong on the issue of degeneracy of hydrogen atomic energy levels, as reported in the literature previously:

80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.

1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

From Ref. #80:

1.) The HUP gives a lower limit to the product of **the *uncertainty* in the momentum and the *uncertainty* in the position—not the product of the momentum and the position**. The momentum or position could be arbitrarily larger or smaller than its uncertainty. For example, QM textbooks express the movement of the electron, and the HUP is an expression of the statistical aspects of this movement. McQuarrie [25], gives the electron speed in the $n = 1$ state of hydrogen as $2.18764\,X10^6\ m/\sec$. Remarkably, the uncertainty in the electron speed according to the HUP is $1.4\,X10^7\ m/\sec$ [26] which is an order of magnitude larger than the speed. The short comings of the theory are obvious given that the constant parameters of the hydrogen atom are known to 10 figure accuracy.

2.) Eq. (3) follows from the Schrodinger equation, not the Bohr theory. In the time independent Schrödinger equation, the kinetic energy of rotation K_{rot} is given by [20]

$$K_{rot} = \frac{\ell(\ell+1)\hbar^2}{2mr^2} \tag{11}$$

where

$$L = \sqrt{\ell(\ell+1)\hbar^2} \tag{12}$$

is the value of the electron angular momentum L for the state $Y_{lm}(\theta,\phi)$.

At page 365 Margenau and Murphy [20] state

" but with the term $\frac{\ell(\ell+1)\hbar^2}{2mr^2}$ added to the normal potential energy. What is the meaning of that term? In classical mechanics, the energy of a particle moving in three dimensions differs from that of a one-dimensional particle by the kinetic energy of rotation, $\frac{1}{2}mr^2\omega^2$. This is precisely the quantity $\frac{\ell(\ell+1)\hbar^2}{2mr^2}$, for we have seen that $\ell(\ell+1)\hbar^2$ is the *certain* value of the square of the angular momentum for the state Y_ℓ, in classical language $(mr^2\omega^2)^2$ which is divided by $2mr^2$, gives exactly the kinetic energy of rotation."

For the n=1 state, $\ell = 0$; thus, **the angular momentum according to the Schrodinger equation is exactly zero—not $\hbar$.** Furthermore, the kinetic energy of rotation K_{rot} is also **zero**. As a consequence, it is internally inconsistent for Feynman to accept the HUP which arises from the Schrodinger equation on the one hand and that the electron obeys the classical Coulomb law and is bound in an inverse squared Coulomb field on the other. Rather than a kinetic energy of $\frac{\hbar^2}{2mr^2}$ which is added to the Coulomb energy of $-\frac{e^2}{r}$ to get the total energy, exactly zero should be added to the Coulomb energy. This is an inescapable nonsensical result which arises from the SE directly, and it can not be saved by incorrectly assigning the angular momentum as $\hbar$ from the uncertainty relationship. Furthermore, the result that L = K_{rot} **= exactly zero violates the HUP making the argument further internally inconsistent.** In addition, applying Eq. (3) to spherical harmonic solutions for Ψ with an exact momentum and energy for a given ℓ in Eqs. (11) and (12), respectively, requires that $\Delta\theta \to \infty$ since $\Delta L = 0$ in the relationship $\Delta L \Delta\theta \geq \frac{\hbar}{2}$. The result $\Delta\theta \to \infty$ is nonsensical. Postulating a linear combination of spherical harmonics is not consistent with a single momentum state and will not save the HUP since the linear combination is not an eigenfunction. Rather it is a wavefunction of a set that is not orthonormal (i.e. it violates QM postulates by not yielding the Kroenecker delta).

20. H. Margenau, G. M. Murphy, *The Mathematics of Chemistry and Physics*, D. Van Nostrand Company, Inc., New York, (1956), Second Edition, pp. 363-367.

From 17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.

In the time independent Schrodinger equation, the kinetic energy of rotation K_{rot} is given by

$$K_{rot} = \frac{\ell(\ell+1)\hbar^2}{2mr^2} \tag{10}$$

where

$$L = \sqrt{\ell(\ell+1)\hbar^2} \tag{11}$$

is the value of the electron angular momentum L for the state $Y_{lm}(\theta,\phi)$.

• In the time independent Schrodinger equation, the kinetic energy of rotation K_{rot} is given by Eq. (10) where the value of the electron angular momentum L for the state $Y_{lm}(\theta,\phi)$ is given by Eq. (11). The Schrodinger equation solutions, Eq. (10) and Eq. (11), predict that the ground state electron has zero angular energy and zero angular momentum, respectively.

• The Schrodinger equation solution, Eq. (11), predicts that the ionized electron may have infinite angular momentum.

• The Schrodinger equation solutions, Eq. (10) and Eq. (11), predict that the excited state rotational energy levels are nondegenerate as a function of the ℓ quantum number even in the absence of an applied magnetic field, and the predicted energy is over six orders of magnitude of the observed nondegenerate energy in the presence of a magnetic field. In the absence of a magnetic field, no preferred direction exists. In this case, the ℓ quantum number is a function of the orientation of the atom with respect to an arbitrary coordinate system. Therefore, the nondegeneracy is nonsensical and violates conservation of angular momentum of the photon.

• The Schrodinger equation predicts that each of the functions that corresponds to a highly excited state electron is not integrable and can not be normalized; thus, each is infinite.

It is trivial to appreciate that SQM fails and does not provide for the degeneracy of the angular momentum and rotational energy in the absence of a magnetic field for the trial case that n=1 with l=0 versus l=1 in Eqs. (10-11).

Section 86

Examiner Souw further errs in arguing on Appendix pages 25-26 that:

The Examiner also takes issue with applicant's removal of $Y_{0,0}$ out of the complete set of angular momentum eigenfunctions $Y_{L,m}$(è,ö). As known in the art, the solutions of an eigenvalue equation form altogether a complete set of eigenfunctions. By taking out $Y_{0,0}$ Applicant's incomplete set of $Y_{L,m}$(è,ö) (L,m>0) is now incapable of representing an arbitrary function of (è,ö), since it is a mathematical rule generally known in the art that an arbitrary function (emphasis on the arbitrary) can only be represented by a complete set of eigenfunctions with all possible values of L, from L=0 to L=8. Thus L=0 cannot be taken out, as done by Applicant. In view of these serious misunderstandings by the applicant, applicant's arguments on angular momentum and spin are unpersuasive.

Applicant does not take Y0,0 out, as shown in Section 84 above and Chp 1 of Mills GUT, while SQM does. It has no rotational energy corresponding to spin angular momentum; yet, it has infinite energy io the electron's magnetic moment of a Bohr magneton.

Section 87

On page 26 of his Appendix, Examiner Souw further argues, erroneously, that:

> Still on pg.55, Applicant's statement *"the Examiner's requirement of taking linear combinations of eigenfunctions to result in a wavefunction solution* *to **avoid violating** the Uncertainty Principle* ", is another example of Applicant's misunderstanding of the Uncertainty Principle, as once again manifested on pg.65 of the amendment discussed below. Either a superposition of eigenfunctions, or a single eigenfunction, are **both** valid manifestations of the Uncertainty Principle, äp?äx?? or äL?äö??, for any two complementary observables. **None** of them violates the Uncertainty Principle, as contended by Applicant. See also the same conceptual mistake in sub-paragraph 6(d) below.

This failure of SQM is discussed in Ref. #80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted, and in Section 85 above.

Section 88

Examiner Souw's erroneous analysis is further exposed by his statements on pages 26-27 of his Appendix:

> (c) Applicant's angular momentum wave functions as postulated (but not derived) in the GUT and repeated on pg.58-64 are mathematically flawed, since they contain mathematical inconsistencies and self-contradictions, as discussed in previous Souw Appendix (sect.6/pg.5-7). Accordingly, Applicant's argument regarding this subject matter is unpersuasive. As pointed out in the previous Appendix (sections 6-8 on pgs. 5-9), Applicant is representing both the spin function ($Y_{o,o}$) and the orbital momentum function ($Y_{l,,m}$, hereinafter denoted by $Y_{L,m}$) in the same space (***r***,t), i.e., as a single function Y= $Y_{o,o}$ + $Y_{L,m}$ (see GUT, Eqs.l.61-1.65). This is a direct contradiction to Applicant's arguments in his present Response, recited on pg.57, (citation:) *"It is physically correct and mathematically*

correct to solve spin and orbital functions <u>*independently*</u> *since there is no a priori reason, why they have to be a single eigenfunction or* <u>*product*</u> ***[sic!]*** *of eigenfunctions. After all, they are independent physical phenomena.* <u>*The two dimensional wave equation*</u> *plus time is given by McQuarrie* [1]").

Most of this statement has been being practiced in science all the time by those ordinarily skilled in the art, except for one which is denoted with ***"[sic!]"***. However, Applicant has obviously misinterpreted his own statement, <u>based on Applicant's own cited reference</u>, i.e., McQuarrie [1] for reasons given in the next paragraph.

The Examiner is trying to fit a square peg in a round hole and insisting that Applicant must do likewise. Applicant has derived the angular momentum of the bound electron from first principles. The Examiner relies on SQM's weird nonphysical probability wave that moves, but has no rotational energy, which is nonsense.

Applicant's derivations are given in Chp. 1 of Mills GUT. The results are used in 100's of calculations that agree remarkably with experiments as shown in Sections 54-55 and 69-70 above and in the following papers:

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.

106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted.

102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One-Through Twenty-Electron Atoms", Physics Essays, submitted.

94. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", Physics Essays, in press.

80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.

58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.

21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.

17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.

5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.

1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey,

Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

Thus, once again Applicant has shown the Examiner to be in error. A summary of the correct way to derive the spin and orbital charge-density functions and corresponding angular momenta and energies is taken from:

106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted is given below:

A. One-Electron Atoms

One-electron atoms include the hydrogen atom, He^{+}, Li^{2+}, Be^{3+}, and so on. The mass-energy and angular momentum of the electron are constant; this requires that the equation of motion of the electron be temporally and spatially harmonic. Thus, the classical wave equation applies and

$$\left[\nabla^2 - \frac{1}{v^2}\frac{\partial^2}{\partial t^2}\right]\rho(r,\theta,\phi,t) = 0 \quad (2)$$

where $\rho(r,\theta,\phi,t)$ is the time dependent charge density function of the electron in time and space. In general, the wave equation has an infinite number of solutions. To arrive at the solution which represents the electron, a suitable boundary condition must be imposed. It is well known from experiments that each single atomic electron of a given isotope radiates to the same stable state. Thus, the physical boundary condition of nonradiation of the bound electron was imposed on the solution of the wave equation for the time dependent charge density function of the electron [1-3, 5]. The condition for radiation by a moving point charge given by Haus [26] is that its spacetime Fourier transform does possess components that are synchronous with waves traveling at the speed of light. Conversely, it is proposed that the condition for nonradiation by an ensemble of moving point charges that comprises a current density function is

For non-radiative states, the current-density function must NOT possess spacetime Fourier components that are synchronous with waves traveling at the speed of light.

The time, radial, and angular solutions of the wave equation are separable. The motion is time harmonic with frequency ω_n. A constant angular function is a solution to the wave equation. Solutions of the Schrödinger wave equation comprising a radial function radiate according to Maxwell's equation as shown previously by application of Haus'

condition [1]. In fact, it was found that any function which permitted radial motion gave rise to radiation. A radial function which does satisfy the boundary condition is a radial delta function

$$f(r) = \frac{1}{r^2}\delta(r - r_n) \quad (3)$$

This function defines a constant charge density on a spherical shell where $r_n = nr_1$ wherein n is an integer in an excited state, and Eq. (2) becomes the two-dimensional wave equation plus time with separable time and angular functions. Given time harmonic motion and a radial delta function, the relationship between an allowed radius and the electron wavelength is given by

$$2\pi r_n = \lambda_n \quad (4)$$

where the integer subscript n here and in Eq. (3) is determined during photon absorption as given in the Excited States of the One-Electron Atom (Quantization) section of Ref. [1]. Using the observed de Broglie relationship for the electron mass where the coordinates are spherical,

$$\lambda_n = \frac{h}{p_n} = \frac{h}{m_e v_n} \quad (5)$$

and the magnitude of the velocity for *every* point on the orbitsphere is

$$v_n = \frac{\hbar}{m_e r_n} \quad (6)$$

The sum of the $|\mathbf{L}_i|$, the magnitude of the angular momentum of each infinitesimal point of the orbitsphere of mass m_i, must be constant. The constant is $\hbar$.

$$\sum|\mathbf{L}_i| = \sum|\mathbf{r} \times m_i\mathbf{v}| = m_e r_n \frac{\hbar}{m_e r_n} = \hbar \quad (7)$$

Thus, an electron is a spinning, two-dimensional spherical surface (zero thickness), called an *electron orbitsphere* shown in Figure 1, that can exist in a bound state at only specified distances from the nucleus determined by an energy minimum. The corresponding current function shown in Figure 2 which gives rise to the phenomenon of *spin* is derived in the Spin Function section. (See the Orbitsphere Equation of Motion for $\ell = 0$ of Ref. [1] at Chp. 1.)

Nonconstant functions are also solutions for the angular functions. To be a harmonic solution of the wave equation in spherical coordinates, these angular functions must be spherical harmonic functions [28]. A zero of the spacetime Fourier transform of the product function of two spherical harmonic angular functions, a time harmonic function, and an unknown radial function is sought. The solution for the radial function which satisfies the boundary condition is also a delta function given by Eq. (3). Thus, bound electrons are described by a charge-density (mass-density) function which is the product of a radial delta function, two angular functions (spherical harmonic functions), and a time harmonic function.

$$\rho(r,\theta,\phi,t) = f(r)A(\theta,\phi,t) = \frac{1}{r^2}\delta(r - r_n)A(\theta,\phi,t); \qquad A(\theta,\phi,t) = Y(\theta,\phi)k(t) \quad (8)$$

In these cases, the spherical harmonic functions correspond to a traveling charge density wave confined to the spherical shell which gives rise to the phenomenon of orbital angular momentum. The orbital functions which modulate the constant "spin" function shown graphically in Figure 3 are given in the Sec. IIC.

B. Spin Function

The orbitsphere spin function comprises a constant charge (current) density function with moving charge confined to a two-dimensional spherical shell. The magnetostatic current pattern of the orbitsphere spin function comprises an infinite series of correlated orthogonal great circle current loops wherein each point charge (current) density element moves time harmonically with constant angular velocity

$$\omega_n = \frac{\hbar}{m_e r_n^2} \quad (9)$$

The uniform current density function $Y_0^0(\phi,\theta)$, the orbitsphere equation of motion of the electron (Eqs. (14-15)), corresponding to the constant charge function of the orbitsphere that gives rise to the spin of the electron is generated from a basis set current-vector field defined as the orbitsphere current-vector field ("orbitsphere-cvf"). This in turn is generated over the surface by two complementary steps of an infinite series of nested rotations of two orthogonal great circle current loops where the coordinate axes rotate with the two orthogonal great circles that serve as a basis set. The algorithm to generate the current density function rotates the great circles and the corresponding x'y'z' coordinates relative to the xyz frame. Each infinitesimal rotation of the infinite series is about the new i'-axis and new j'-axis which results from the preceding such rotation. Each element of the current density function is obtained with each conjugate set of rotations. In Appendix III of Ref. [1], the *continuous* uniform electron current density function $Y_0^0(\phi,\theta)$ having the same angular momentum components as that of the orbitsphere-cvf is then exactly generated from this orbitsphere-cvf as a basis element by a convolution operator comprising an autocorrelation-type function.

For Step One, the current density elements move counter clockwise on the great circle in the y'z'-plane and move clockwise on the great circle in the x'z'-plane. The great circles are rotated by an infinitesimal angle $\pm\Delta\alpha_{i'}$ (a positive rotation around the x'-axis or a negative rotation about the z'-axis for Steps One and Two, respectively) and then by $\pm\Delta\alpha_{j'}$ (a positive rotation around the new y'-axis or a positive rotation about the new x'-axis for Steps One and Two, respectively). The coordinates of each point on each rotated great circle (x',y',z') is expressed in terms of the first (x,y,z) coordinates by the following transforms where clockwise rotations and motions are defined as positive looking along the corresponding axis:

Step One

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \cos(\Delta\alpha_y) & 0 & -\sin(\Delta\alpha_y) \\ 0 & 1 & 0 \\ \sin(\Delta\alpha_y) & 0 & \cos(\Delta\alpha_y) \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\Delta\alpha_x) & \sin(\Delta\alpha_x) \\ 0 & -\sin(\Delta\alpha_x) & \cos(\Delta\alpha_x) \end{bmatrix} \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \cos(\Delta\alpha_y) & \sin(\Delta\alpha_y)\sin(\Delta\alpha_x) & -\sin(\Delta\alpha_y)\cos(\Delta\alpha_x) \\ 0 & \cos(\Delta\alpha_x) & \sin(\Delta\alpha_x) \\ \sin(\Delta\alpha_y) & -\cos(\Delta\alpha_y)\sin(\Delta\alpha_x) & \cos(\Delta\alpha_y)\cos(\Delta\alpha_x) \end{bmatrix} \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} \tag{10}$$

Step Two

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\Delta\alpha_x) & \sin(\Delta\alpha_x) \\ 0 & -\sin(\Delta\alpha_x) & \cos(\Delta\alpha_x) \end{bmatrix} \begin{bmatrix} \cos(\Delta\alpha_z) & \sin(\Delta\alpha_z) & 0 \\ -\sin(\Delta\alpha_z) & \cos(\Delta\alpha_z) & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \cos(\Delta\alpha_z) & \sin(\Delta\alpha_z) & 0 \\ -\cos(\Delta\alpha_x)\sin(\Delta\alpha_z) & \cos(\Delta\alpha_x)\cos(\Delta\alpha_z) & \sin(\Delta\alpha_x) \\ \sin(\Delta\alpha_x)\sin(\Delta\alpha_z) & -\sin(\Delta\alpha_x)\cos(\Delta\alpha_z) & \cos(\Delta\alpha_x) \end{bmatrix} \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} \tag{11}$$

where the angular sum is $\lim_{\Delta\alpha \to 0} \sum_{n=1}^{\frac{\frac{\sqrt{2}}{2}\pi}{|\Delta\alpha_{i',j'}|}} |\Delta\alpha_{i',j'}| = \frac{\sqrt{2}}{2}\pi$.

The orbitsphere-cvf is given by n reiterations of Eqs. (10) and (11) for each point on each of the two orthogonal great circles during each of

Steps One and Two. The output given by the non-primed coordinates is the input of the next iteration corresponding to each successive nested rotation by the infinitesimal angle $\pm\Delta\alpha_{i'}$ or $\pm\Delta\alpha_{j'}$ where the magnitude of the angular sum of the n rotations about each of the i'-axis and the j'-axis is $\frac{\sqrt{2}}{2}\pi$. Half of the orbitsphere-cvf is generated during each of Steps One and Two.

Following Step Two, in order to match the boundary condition that the magnitude of the velocity at any given point on the surface is given by Eq. (6), the output half of the orbitsphere-cvf is rotated clockwise by an angle of $\frac{\pi}{4}$ about the z-axis. Using Eq. (11) with $\Delta\alpha_{z'} = \frac{\pi}{4}$ and $\Delta\alpha_{x'} = 0$ gives the rotation. Then, the one half of the orbitsphere-cvf generated from Step One is superimposed with the complementary half obtained from Step Two following its rotation about the z-axis of $\frac{\pi}{4}$ to give the basis function to generate $Y_0^{\,0}(\phi,\theta)$, the orbitsphere equation of motion of the electron.

The current pattern of the orbitsphere-cvf generated by the nested rotations of the orthogonal great circle current loops is a continuous and total coverage of the spherical surface, but it is shown as a visual representation using 6 degree increments of the infinitesimal angular variable $\pm\Delta\alpha_{i'}$ and $\pm\Delta\alpha_{j'}$ of Eqs. (10) and (11) from the perspective of the z-axis in Figure 2. In each case, the complete orbitsphere-cvf current pattern corresponds all the orthogonal-great-circle elements which are generated by the rotation of the basis-set according to Eqs. (10) and (11) where $\pm\Delta\alpha_{i'}$ and $\pm\Delta\alpha_{j'}$ approach zero and the summation of the infinitesimal angular rotations of $\pm\Delta\alpha_{i'}$ and $\pm\Delta\alpha_{j'}$ about the successive i'-axes and j'-axes is $\frac{\sqrt{2}}{2}\pi$ for each Step. The current pattern gives rise to the phenomenon corresponding to the spin quantum number. The details of the derivation of the spin function are given in Ref. [3] and Chp. 1 of Ref. [1].

The resultant angular momentum projections of $\mathbf{L}_{xy} = \frac{\hbar}{4}$ and $\mathbf{L}_z = \frac{\hbar}{2}$ meet the boundary condition for the unique current having an angular velocity magnitude at each point on the surface given by Eq. (6) and give rise to the Stern Gerlach experiment as shown in Ref. [1]. The further constraint that the current density is uniform such that the charge density is uniform, corresponding to an equipotential, minimum energy surface is satisfied by using the orbitsphere-cvf as a basis element to generate $Y_0^{\,0}(\phi,\theta)$ using a convolution operator comprising an autocorrelation-type function as given in Appendix III of Ref. [1]. The operator comprises the convolution of each great circle current loop of the orbitsphere-cvf designated as the primary orbitsphere-cvf with a second orbitsphere-cvf designated as the

secondary orbitsphere-cvf wherein the convolved secondary elements are matched for orientation, angular momentum, and phase to those of the primary. The resulting exact uniform current distribution obtained from the convolution has the same angular momentum distribution, resultant, $\mathbf{L_R}$, and components of $\mathbf{L}_{xy} = \frac{\hbar}{4}$ and $\mathbf{L}_z = \frac{\hbar}{2}$ as those of the orbitsphere-cvf used as a primary basis element.

C. Angular Functions

The time, radial, and angular solutions of the wave equation are separable. Also based on the radial solution, the angular charge and current-density functions of the electron, $A(\theta,\phi,t)$, must be a solution of the wave equation in two dimensions (plus time),

$$\left[\nabla^2 - \frac{1}{v^2}\frac{\partial^2}{\partial t^2}\right]A(\theta,\phi,t) = 0 \quad (12)$$

where $\rho(r,\theta,\phi,t) = f(r)A(\theta,\phi,t) = \frac{1}{r^2}\delta(r-r_n)A(\theta,\phi,t)$ and
$A(\theta,\phi,t) = Y(\theta,\phi)k(t)$

$$\left[\frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial}{\partial\theta}\right)_{r,\phi} + \frac{1}{r^2\sin^2\theta}\left(\frac{\partial^2}{\partial\phi^2}\right)_{r,\theta} - \frac{1}{v^2}\frac{\partial^2}{\partial t^2}\right]A(\theta,\phi,t) = 0 \quad (13)$$

where v is the linear velocity of the electron. The charge-density functions including the time-function factor are

$\ell = 0$

$$\rho(r,\theta,\phi,t) = \frac{e}{8\pi r^2}[\delta(r-r_n)]\left[Y_0^0(\theta,\phi) + Y_\ell^m(\theta,\phi)\right] \quad (14)$$

$\ell \neq 0$

$$\rho(r,\theta,\phi,t) = \frac{e}{4\pi r^2}[\delta(r-r_n)]\left[Y_0^0(\theta,\phi) + \mathrm{Re}\left\{Y_\ell^m(\theta,\phi)e^{i\omega_n t}\right\}\right] \quad (15)$$

where $Y_\ell^m(\theta,\phi)$ are the spherical harmonic functions that spin about the z-axis with angular frequency ω_n with $Y_0^0(\theta,\phi)$ the constant function.
$\mathrm{Re}\left\{Y_\ell^m(\theta,\phi)e^{i\omega_n t}\right\} = P_\ell^m(\cos\theta)\cos(m\phi + \omega_n' t)$ where to keep the form of the spherical harmonic as a traveling wave about the z-axis, $\omega_n' = m\omega_n$.

D. Acceleration without Radiation

a. Special Relativistic Correction to the Electron Radius

The relationship between the electron wavelength and its radius is given by Eq. (4) where λ is the de Broglie wavelength. For each current

density element of the spin function, the distance along each great circle in the direction of instantaneous motion undergoes length contraction and time dilation. Using a phase matching condition, the wavelengths of the electron and laboratory inertial frames are equated, and the corrected radius is given by

$$r_n = r_n'\left[\sqrt{1-\left(\frac{v}{c}\right)^2}\sin\left[\frac{\pi}{2}\left(1-\left(\frac{v}{c}\right)^2\right)^{3/2}\right]+\frac{1}{2\pi}\cos\left[\frac{\pi}{2}\left(1-\left(\frac{v}{c}\right)^2\right)^{3/2}\right]\right] \quad (16)$$

where the electron velocity is given by Eq. (6). (See Ref. [1] Chp. 1, Special Relativistic Correction to the Ionization Energies section). $\frac{e}{m_e}$ of the electron, the electron angular momentum of $\hbar$, and μ_B are invariant, but the mass and charge densities increase in the laboratory frame due to the relativistically contracted electron radius. As $v \to c$, $r/r' \to \frac{1}{2\pi}$ and $r = \lambda$ as shown in Figure 4.

b. Nonradiation Based on the Spacetime Fourier Transform of the Electron Current

The Fourier transform of the electron charge density function given by Eq. (8) is a solution of the three-dimensional wave equation in frequency space ($\mathbf{k},\omega\, space$) as given in Chp 1, Spacetime Fourier Transform of the Electron Function section of Ref. [1]. Then the corresponding Fourier transform of the current density function $K(s,\Theta,\Phi,\omega)$ is given by multiplying by the constant angular frequency.

$$K(s,\Theta,\Phi,\omega) = 4\pi\omega_n\frac{\sin(2s_nr_n)}{2s_nr_n}\otimes 2\pi\sum_{\upsilon=1}^{\infty}\frac{(-1)^{\upsilon-1}(\pi\sin\Theta)^{2(\upsilon-1)}}{(\upsilon-1)!(\upsilon-1)!}\frac{\Gamma\left(\frac{1}{2}\right)\Gamma\left(\upsilon+\frac{1}{2}\right)}{(\pi\cos\Theta)^{2\upsilon+1}2^{\upsilon+1}}\frac{2\upsilon!}{(\upsilon-1)!}s^{-2\upsilon}$$
$$\otimes 2\pi\sum_{\upsilon=1}^{\infty}\frac{(-1)^{\upsilon-1}(\pi\sin\Phi)^{2(\upsilon-1)}}{(\upsilon-1)!(\upsilon-1)!}\frac{\Gamma\left(\frac{1}{2}\right)\Gamma\left(\upsilon+\frac{1}{2}\right)}{(\pi\cos\Phi)^{2\upsilon+1}2^{\upsilon+1}}\frac{2\upsilon!}{(\upsilon-1)!}s^{-2\upsilon}\frac{1}{4\pi}[\delta(\omega-\omega_n)+\delta(\omega+\omega_n)]$$

(17)

$\mathbf{s}_n \bullet \mathbf{v}_n = \mathbf{s}_n \bullet \mathbf{c} = \omega_n$ implies $r_n = \lambda_n$ which is given by Eq. (16) in the case that k is the lightlike k^0. In this case, Eq. (17) vanishes. Consequently, spacetime harmonics of $\frac{\omega_n}{c} = k$ or $\frac{\omega_n}{c}\sqrt{\frac{\varepsilon}{\varepsilon_o}} = k$ for which the Fourier transform of the current-density function is nonzero do not exist. Radiation due to charge motion does not occur in any medium when this boundary condition is met. Nonradiation is also determined directly from the fields based on Maxwell's equations as given in Sec. IIDc.

c. Nonradiation Based on the Electron Electromagnetic Fields and the Poynting Power Vector

A point charge undergoing periodic motion accelerates and as a consequence radiates according to the Larmor formula:

$$P = \frac{1}{4\pi\varepsilon_0}\frac{2e^2}{3c^3}a^2 \quad (18)$$

where e is the charge, a is its acceleration, ε_0 is the permittivity of free space, and c is the speed of light. Although an accelerated *point* particle radiates, an *extended distribution* modeled as a superposition of accelerating charges does not have to radiate [21, 26, 29-31]. In Ref. [3] and Appendix I, Chp. 1 of Ref. [1], the electromagnetic far field is determined from the current distribution in order to obtain the condition, if it exists, that the electron current distribution must satisfy such that the electron does not radiate. The current follows from Eqs. (14-15). The currents corresponding to Eq. (14) and first term of Eq. (15) are static. Thus, they are trivially nonradiative. The current due to the time dependent term of Eq. (15) corresponding to p, d, f, etc. orbitals is

$$\begin{aligned}\mathbf{J} &= \frac{\omega_n}{2\pi}\frac{e}{4\pi r_n^2}N[\delta(r-r_n)]\mathrm{Re}\{Y_\ell^m(\theta,\phi)\}[\mathbf{u}(t)\times\mathbf{r}] \\ &= \frac{\omega_n}{2\pi}\frac{e}{4\pi r_n^2}N'[\delta(r-r_n)]\left(P_\ell^m(\cos\theta)\cos(m\phi+\omega_n' t)\right)[\mathbf{u}\times\mathbf{r}] \quad (19) \\ &= \frac{\omega_n}{2\pi}\frac{e}{4\pi r_n^2}N'[\delta(r-r_n)]\left(P_\ell^m(\cos\theta)\cos(m\phi+\omega_n' t)\right)\sin\theta\hat{\phi}\end{aligned}$$

where to keep the form of the spherical harmonic as a traveling wave about the z-axis, $\omega_n' = m\omega_n$ and N and N' are normalization constants. The vectors are defined as

$$\hat{\phi} = \frac{\hat{u}\times\hat{r}}{|\hat{u}\times\hat{r}|} = \frac{\hat{u}\times\hat{r}}{\sin\theta}; \qquad \hat{u} = \hat{z} = orbital\ axis \quad (20)$$

$$\hat{\theta} = \hat{\phi}\times\hat{r} \quad (21)$$

"^" denotes the unit vectors $\hat{u} \equiv \frac{\mathbf{u}}{|\mathbf{u}|}$, non-unit vectors are designed in bold, and the current function is normalized. For the electron source current given by Eq. (19), each comprising a multipole of order (ℓ,m) with a time dependence $e^{i\omega_n t}$, the far-field solutions to Maxwell's equations are given by

$$\begin{aligned}\mathbf{B} &= -\frac{i}{k}a_M(\ell,m)\nabla\times g_\ell(kr)\mathbf{X}_{\ell,m} \\ \mathbf{E} &= a_M(\ell,m)g_\ell(kr)\mathbf{X}_{\ell,m}\end{aligned} \quad (22)$$

and the time-averaged power radiated per solid angle $\frac{dP(\ell,m)}{d\Omega}$ is

$$\frac{dP(\ell,m)}{d\Omega} = \frac{c}{8\pi k^2}|a_M(\ell,m)|^2|\mathbf{X}_{\ell,m}|^2 \quad (23)$$

where $a_M(\ell,m)$ is

$$a_M(\ell,m) = \frac{-ek^2}{c\sqrt{\ell(\ell+1)}}\frac{\omega_n}{2\pi}Nj_\ell(kr_n)\Theta\sin(mks) \quad (24)$$

In the case that k is the lightlike k^0, then $k = \omega_n / c$, in Eq. (24), and Eqs. (22-23) vanishes for

$$s = vT_n = R = r_n = \lambda_n \quad (25)$$

There is no radiation.

E. Magnetic Field Equations of the Electron

The orbitsphere is a shell of negative charge current comprising correlated charge motion along great circles. For $\ell = 0$, the orbitsphere gives rise to a magnetic moment of 1 Bohr magneton [32]. (The details of the derivation of the magnetic parameters including the electron g factor are given in Ref. [3] and Chp. 1 of Ref. [1].)

$$\mu_B = \frac{e\hbar}{2m_e} = 9.274\,X\,10^{-24}\,JT^{-1} \quad (26)$$

The magnetic field of the electron shown in Figure 5 is given by

$$\mathbf{H} = \frac{e\hbar}{m_e r_n^3}(\mathbf{i}_r \cos\theta - \mathbf{i}_\theta \sin\theta) \qquad \text{for } r < r_n \quad (27)$$

$$\mathbf{H} = \frac{e\hbar}{2m_e r^3}(\mathbf{i}_r 2\cos\theta + \mathbf{i}_\theta \sin\theta) \qquad \text{for } r > r_n \quad (28)$$

The energy stored in the magnetic field of the electron is

$$E_{mag} = \frac{1}{2}\mu_o \int_0^{2\pi}\int_0^{\pi}\int_0^{\infty} H^2 r^2 \sin\theta dr d\theta d\Phi \quad (29)$$

$$E_{mag\ \text{total}} = \frac{\pi\mu_o e^2\hbar^2}{m_e^2 r_1^3} \quad (30)$$

F. Stern-Gerlach Experiment

The Stern-Gerlach experiment implies a magnetic moment of one Bohr magneton and an associated angular momentum quantum number of 1/2. Historically, this quantum number is called the spin quantum number, s ($s = \frac{1}{2}$; $m_s = \pm\frac{1}{2}$). The superposition of the vector projection of the orbitsphere angular momentum on the z-axis is $\frac{\hbar}{2}$ with an orthogonal component of $\frac{\hbar}{4}$. Excitation of a resonant Larmor precession gives rise to $\hbar$ on an axis $\mathbf{S}$ that precesses about the z-axis called the spin axis at the Larmor frequency at an angle of $\theta = \frac{\pi}{3}$ to give a perpendicular projection of

$$\mathbf{S}_\perp = \hbar\sin\frac{\pi}{3} = \pm\sqrt{\frac{3}{4}}\hbar\,\mathbf{i}_{Y_R} \quad (31)$$

and a projection onto the axis of the applied magnetic field of

$$\mathbf{S}_{\|} = \hbar \cos\frac{\pi}{3} = \pm\frac{\hbar}{2}\mathbf{i}_z \quad (32)$$

The superposition of the $\frac{\hbar}{2}$, z-axis component of the orbitsphere angular momentum and the $\frac{\hbar}{2}$, z-axis component of $\mathbf{S}$ gives $\hbar$ corresponding to the observed electron magnetic moment of a Bohr magneton, μ_B.

G. Electron g Factor

Conservation of angular momentum of the orbitsphere permits a discrete change of its "kinetic angular momentum" $(\mathbf{r} \times m\mathbf{v})$ by the applied magnetic field of $\frac{\hbar}{2}$, and concomitantly the "potential angular momentum" $(\mathbf{r} \times e\mathbf{A})$ must change by $-\frac{\hbar}{2}$.

$$\Delta\mathbf{L} = \frac{\hbar}{2} - \mathbf{r} \times e\mathbf{A} \quad (33)$$

$$= \left[\frac{\hbar}{2} - \frac{e\phi}{2\pi}\right]\hat{z} \quad (34)$$

In order that the change of angular momentum, $\Delta\mathbf{L}$, equals zero, ϕ must be $\Phi_0 = \frac{h}{2e}$, the magnetic flux quantum. The magnetic moment of the electron is parallel or antiparallel to the applied field only. During the spin-flip transition, power must be conserved. Power flow is governed by the Poynting power theorem,

$$\nabla \bullet (\mathbf{E} \times \mathbf{H}) = -\frac{\partial}{\partial t}\left[\frac{1}{2}\mu_o \mathbf{H} \bullet \mathbf{H}\right] - \frac{\partial}{\partial t}\left[\frac{1}{2}\varepsilon_o \mathbf{E} \bullet \mathbf{E}\right] - \mathbf{J} \bullet \mathbf{E} \quad (35)$$

Eq. (36) gives the total energy of the flip transition which is the sum of the energy of reorientation of the magnetic moment (1st term), the magnetic energy (2nd term), the electric energy (3rd term), and the dissipated energy of a fluxon treading the orbitsphere (4th term), respectively,

$$\Delta E_{mag}^{spin} = 2\left(1 + \frac{\alpha}{2\pi} + \frac{2}{3}\alpha^2\left(\frac{\alpha}{2\pi}\right) - \frac{4}{3}\left(\frac{\alpha}{2\pi}\right)^2\right)\mu_B B \quad (36)$$

$$\Delta E_{mag}^{spin} = g\mu_B B \quad (37)$$

where the stored magnetic energy corresponding to the $\frac{\partial}{\partial t}\left[\frac{1}{2}\mu_o \mathbf{H} \bullet \mathbf{H}\right]$ term increases, the stored electric energy corresponding to the $\frac{\partial}{\partial t}\left[\frac{1}{2}\varepsilon_o \mathbf{E} \bullet \mathbf{E}\right]$ term increases, and the $\mathbf{J} \bullet \mathbf{E}$ term is dissipative. The spin-flip transition can be considered as involving a magnetic moment of g times that of a Bohr magneton. The g factor is redesignated the fluxon g factor as opposed to the anomalous g factor. Using $\alpha^{-1} = 137.03603(82)$,

the calculated value of $\frac{g}{2}$ is $1.001\ 159\ 652\ 137$. The experimental value [33] of $\frac{g}{2}$ is $1.001\ 159\ 652\ 188(4)$.

H. Spin and Orbital Parameters

The total function that describes the spinning motion of each electron orbitsphere is composed of two functions. One function, the spin function, is spatially uniform over the orbitsphere, spins with a quantized angular velocity, and gives rise to spin angular momentum. The other function, the modulation function, can be spatially uniform—in which case there is no orbital angular momentum and the magnetic moment of the electron orbitsphere is one Bohr magneton—or not spatially uniform—in which case there is orbital angular momentum. The modulation function also rotates with a quantized angular velocity.

The spin function of the electron corresponds to the nonradiative $n=1$, $\ell=0$ state of atomic hydrogen which is well known as an s state or orbital. (See Figure 1 for the charge function and Figure 2 for the current function.) In cases of orbitals of heavier elements and excited states of one electron atoms and atoms or ions of heavier elements with the ℓ quantum number not equal to zero and which are not constant as given by Eq. (14), the constant spin function is modulated by a time and spherical harmonic function as given by Eq. (15) and shown in Figure 3. The modulation or traveling charge density wave corresponds to an orbital angular momentum in addition to a spin angular momentum. These states are typically referred to as p, d, f, etc. orbitals. Application of Haus's [26] condition also predicts nonradiation for a constant spin function modulated by a time and spherically harmonic orbital function. There is acceleration without radiation as also shown in Sec. IIDc. (Also see Abbott and Griffiths, Goedecke, and Daboul and Jensen [29-31]). However, in the case that such a state arises as an excited state by photon absorption, it is radiative due to a radial dipole term in its current density function since it possesses spacetime Fourier Transform components synchronous with waves traveling at the speed of light [26]. (See Instability of Excited States section of Ref. [1].)

a. Moment of Inertia and Spin and Rotational Energies

The moments of inertia and the rotational energies as a function of the ℓ quantum number for the solutions of the time-dependent electron charge density functions (Eqs. (14-15)) given in Sec. IIC are solved using the rigid rotor equation [28]. The details of the derivations of the results as well as the demonstration that Eqs. (14-15) with the results given *infra.* are solutions of the wave equation are given in Chp 1, Rotational Parameters of the Electron (Angular Momentum, Rotational Energy, Moment of Inertia) section of Ref. [1].

$\ell = 0$

$$I_z = I_{spin} = \frac{m_e r_n^2}{2} \quad (38)$$

$$L_z = I\omega \mathbf{i}_z = \pm\frac{\hbar}{2} \quad (39)$$

$$E_{rotational} = E_{rotational,\,spin} = \frac{1}{2}\left[I_{spin}\left(\frac{\hbar}{m_e r_n^2}\right)^2\right] = \frac{1}{2}\left[\frac{m_e r_n^2}{2}\left(\frac{\hbar}{m_e r_n^2}\right)^2\right] = \frac{1}{4}\left[\frac{\hbar^2}{2I_{spin}}\right] \quad (40)$$

$$T = \frac{\hbar^2}{2m_e r_n^2} \quad (41)$$

$\ell \neq 0$

$$I_{orbital} = m_e r_n^2 \left[\frac{\ell(\ell+1)}{\ell^2+2\ell+1}\right]^{\frac{1}{2}} = m_e r_n^2 \sqrt{\frac{\ell}{\ell+1}} \quad (42)$$

$$\mathbf{L} = I\omega \mathbf{i}_z = I_{orbital}\omega \mathbf{i}_z = m_e r_n^2 \left[\frac{\ell(\ell+1)}{\ell^2+2\ell+1}\right]^{\frac{1}{2}} \omega \mathbf{i}_z = m_e r_n^2 \frac{\hbar}{m_e r_n^2}\sqrt{\frac{\ell}{\ell+1}} = \hbar\sqrt{\frac{\ell}{\ell+1}} \quad (43)$$

$$L_{z\,total} = L_{z\,spin} + L_{z\,orbital} \quad (44)$$

$$E_{rotational\ \mathrm{orbital}} = \frac{\hbar^2}{2I}\left[\frac{\ell(\ell+1)}{\ell^2+2\ell+1}\right] = \frac{\hbar^2}{2I}\left[\frac{\ell}{\ell+1}\right] = \frac{\hbar^2}{2m_e r_n^2}\left[\frac{\ell}{\ell+1}\right] \quad (45)$$

$$\langle L_{z\ orbital}\rangle = 0 \quad (46)$$

$$\langle E_{rotational\ \mathrm{orbital}}\rangle = 0 \quad (47)$$

The orbital rotational energy arises from a spin function (spin angular momentum) modulated by a spherical harmonic angular function (orbital angular momentum). The time-averaged mechanical angular momentum and rotational energy associated with the wave-equation solution comprising a traveling charge-density wave on the orbitsphere is zero as given in Eqs. (46) and (47), respectively. Thus, the principal levels are degenerate except when a magnetic field is applied. In the case of an excited state, the angular momentum of $\hbar$ is carried by the fields of the trapped photon. The amplitudes that couple to external magnetic and electromagnetic fields are given by Eq. (43) and (45), respectively. The rotational energy due to spin is given by Eq. (40), and the total kinetic energy is given by Eq. (41).

Section 89

Examiner Souw argues on page 27 of the Appendix that:

(c. 1) Firstly, McQuarrie's spin-orbital eigenfunction ø100±_ as defined in Eqs.8-50 and 8-5 1, is a product of the orbital eigenfunction ø100 (see Table 6-5 on pg. 224) and the spin eigenfunction á and/or â, the latter

defined independently by Eqs. 8-43 and 8-46. In contradiction to Applicant's misunderstanding, it is just because it is product, can the resulting wavefunction remain an eigenfunction of both the angular and the spin operators! Thus, that part of Applicant's statement denoted by ***[sic!]*** is fundamentally incorrect.

Once again, the Examiner simply argues the experimentally proven-wrong approach of SQM. Applicant uses the correct approach based on physical laws as given in Sections 82-88 above.

Section 90

Examiner Souw merely continues to make the same analysis errors in his argument on Appendix pages 27-28:

> (c.2) Secondly, Applicant's new statement cited above is a contradiction to Applicant's angular momentum (spin-orbital) wave function given in GUT, Eqs. 1.61-1.65, in which the spin wavefunction ($Y_{o,o}$) and the orbital wavefunction ($Y_{L,m}$) are both solutions of the <u>same</u> equation, and represented by one spin-orbital function in the form of an <u>addition</u> of two functions in the <u>same</u> and <u>single</u> *(r,t)* space, i.e., $YY_{0,0}+Y_{L,m}$, but <u>not</u> in two independent functions, ø=ø?á and ø=ø?â as correctly stated by McQuarrie in Eq. 8-50. What Applicant would mean with McQuarrie's *"two dimensional wave equation"* has its solution defined in a two-dimensional space as a (2-dimensional vector) functions á and â defined in McQuarrie's Eq. 8-43. These á and â are known in the art as representing two linearly independent eigenfunctions, or basis vectors, that can (but not must) be conveniently represented by á=[1,0] and â=[0, 1], which are obviously orthogonal for satisfying the orthogonality condition in Eq.8-46 on pg.300, and yet <u>fully different than -- and fully independent of-- the ordinary space</u> (***r***,t). (<u>Note</u>: *As generally known in the art, McQuarrie's orthogonality condition in the form of integrals over a not further-specified spin variable ó (Eq.8-46) is greatly simplified by defining --with Pauli— the spin functions á and â in its equivalent vector form,* **á** *and* **â**, *which is mathematically more elegant and also conventional).* In contrast, although Applicant's $Y_{0,0}$ is constant, it is still a function defined in the <u>same</u> and <u>single</u> space(***r***,t) as $Y_{L,m}$, and hence, <u>does not comply with Applicant's own new statement.</u>

The Examiner simply doesn't get it. The rules of SQM may be taught in textbooks, but the results are <u>not</u> correct. Applicant has found a different physical path that overcomes the failures of the SQM approach. In other words, Applicant agrees

with the Examiner that he is not following the mathematical postulates and rules of SQM. Rather, Applicant is deriving results based on physical laws. The agreement of predictions with observations show that SQM is wrong and CQM is right.

Applicant's solution for the spin function, which corresponds to a current, is in accord with physical laws. (This is opposed to the case of SQM, wherein the electron has current in zero dimensional space. This inescapable feature of SQM is nonsensical and corresponds to a further violation of physical laws in contradiction to the Examiner's insistence that he is following physical laws.) Superimposed on the CQM spin current is the independent spherically-harmonic charge-density wave that travels time-harmonically on the two-dimensional surface of the electron and modulates the constant spin function. The modulation function averages to zero; yet, it gives rise to orbital splitting in the presence of a magnetic field. The results match experiments exactly in contrast to the SQM predictions. Modulation is a common physical phenomenon. Ripples on traveling fluid flow, air flow, etc., and AC modulation of a DC current are just some of the infinite physical possibilities. In all cases, the modulation occurs at the same positions in space as the constant term. Thus, the reason that the Examiner believes Applicant's use of CQM gives rise to a contradiction is that SQM is nonphysical and follows mathematical rules, which, by the Examiner's own analysis, demonstrates the impossibility of modulation of a constant parameter such as current. This further proves that SQM is nonphysical, purely mathematical, and not based in the reality of the physical world.

<u>Section 91</u>

Examiner Souw's erroneous analysis continues on pages 28-29 of his Appendix with the following misguided statements:

> (c.3) Thirdly, Applicant has misrepresented his own cited reference [1], the latter unambiguously reciting on pg.300, *"In a sense, á= $Y_{\_,+\_}$ and â= $Y_{\_,-\_}$, but this is <u>strictly formal</u> <u>association</u>, and á and â, and even $\mathbf{S}^2$ and $\mathbf{S}_Z$, for that matter, <u>do not have to be specified any further.</u>"* Thus, it is principally incorrect to interpret $Y_{\_,\pm\_}$ as being the same orbital function $Y_{L,m}$, but with L=_ and m=±_. In fact, it is mathematically impossible to do so, simply because the (bounded) solution of the pertinent differential equation requires L to be an integer (see McQuarrie [1], Eq. 6-101). It is

> further recited on the next line," *The functions á and â in Eq.8-43 are called spin eigenfunctions" ...., which we write* formally *as ...*" followed by defining its orthonormal properties in Eq.8-46. As known in the art, it is sufficient and correct to define the spin functions á and â as in Eq. 8-43, together with their orthogonality condition as defined in Eq.8-46. Obviously, what is correctly meant by McQuarrie with $Y_{\_,\pm\_}$ *as formally* representing the spin functions á and â is not $Y_{0,0}$, as insisted by Applicant in his response and in his GUT (Eqs.1 .61-1.65). As generally known in the art what McQuarrie meant with á and â are the Pauli spin eigenfunctions, **á**[1,0] and **â**[0, 1], respectively, which are column vectors that should be rigorously written in columns, i.e., one component above the other (as used by the Examiner in his cited own work [3] as well by a many other authors), instead of sequential rows, i.e., one component after the other.

It is trivial to show that inputting a constant to the two-dimensional wave equation plus time gives zero. Thus, a constant function is a solution. Applicant's spin function provides for the stability of the hydrogen atom, it is relativistically invariant, and it reproduces all aspects of electron spin.

It is time to discard all of the jargon, mathematical rules, nonphysical weirdness etc., such as Pauli spin eigenfunctions, **á**[1,0] and **â**[0, 1], respectively, which are column vectors that should be rigorously written in columns, i.e., one component above the other (as used by the Examiner in his cited own work [3] as well by a many other authors), instead of sequential rows, i.e., one component after the other.

This is not physics. The Schrodinger equation did not predict spin. Then, many other theoreticians, including Dirac, tried to solve the physical electron using Maxwell's equations to give rise to electron spin. This was an obvious issue as noted by Einstein:

You know, it would be sufficient to really understand the electron.

Albert Einstein

H. Dehmelt' "Experiments with an isolated subatomic particle at rest", Reviews of Modern Physics, Vol. 62, No. 3, (1990), pp. 525-530.

The current postulate of "inherent spin" is unsatisfactory. It has caused more problems than it was solved. It is easy to appreciate that the SQM picture is not predictive. There have been many failures of the SQM picture of the electron zero-dimensions. For example:

> "They also laid to rest Wolfgang Pauli's assertions (3,6)—backed by Niels Bohr—that the spin magnetic moment of the electron could never be measured on free electrons, that is, electrons not bound to a nucleus, by means of spin-dependent changes in classical orbits. [1]

1. H. Dehmelt, "Experiments on the Structure of an Individual Elementary Particle", Science, Vol. 234, (1990), pp. 539-554.

Even the title of the article according to SQM is an impossible situation:

H. Dehmelt' "Experiments with an isolated subatomic particle at rest", Reviews of Modern Physics, Vol. 62, No. 3, (1990), pp. 525-530.

Others failed to solve this problem and desperately resorted to the "intrinsic-spin" postulate. Applicant has solved the electron physically and the results work where SQM has failed. The approach is summarized in

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted:

III. Classical Quantum Theory of the Atom Based on Maxwell's Equations

In this paper, the old view that the electron is a zero or one-dimensional point in an all-space probability wave function $\Psi(x)$ is not taken for granted. The theory of classical quantum mechanics (CQM), derived from first principles, must successfully and consistently apply physical laws on all scales [2-10]. Stability to radiation was ignored by all past atomic models. Historically, the point at which QM broke with classical laws can be traced to the issue of nonradiation of the one electron atom. Bohr just postulated orbits stable to radiation with the further postulate that the bound electron of the hydrogen atom does not obey Maxwell's equations—rather it obeys

different physics [2, 7]. Later physics was replaced by "pure mathematics" based on the notion of the inexplicable wave-particle duality nature of electrons which lead to the Schrödinger equation wherein the consequences of radiation predicted by Maxwell's equations were ignored. Ironically, Bohr, Schrödinger, and Dirac used the Coulomb potential, and Dirac used the vector potential of Maxwell's equations. But, all ignored electrodynamics and the corresponding radiative consequences. Dirac originally attempted to solve the bound electron physically with stability with respect to radiation according to Maxwell's equations with the further constraints that it was relativistically invariant and gave rise to electron spin [37]. He and many founders of QM such as Sommerfeld, Bohm, and Weinstein wrongly pursued a planetary model, were unsuccessful, and resorted to the current mathematical-probability-wave model that has many problems [1-10, 19, 22-23, 37]. Consequently, Feynman for example, attempted to use first principles including Maxwell's equations to discover new physics to replace quantum mechanics [38].

Physical laws may indeed be the root of the observations thought to be "purely quantum mechanical", and it may have been a mistake to make the assumption that Maxwell's electrodynamic equations must be rejected at the atomic level. Thus, in the present approach, the classical wave equation is solved with the constraint that a bound $n = 1$-state electron cannot radiate energy.

Herein, derivations consider the electrodynamic effects of moving charges as well as the Coulomb potential, and the search is for a solution representative of the electron wherein there is acceleration of charge motion without radiation. The mathematical formulation for zero radiation based on Maxwell's equations follows from a derivation by Haus [39]. The function that describes the motion of the electron must not possess spacetime Fourier components that are synchronous with waves traveling at the speed of light. Similarly, nonradiation is demonstrated based on the electron's electromagnetic fields and the Poynting power vector.

It was shown previously [3-8] that CQM gives closed form solutions for the atom including the stability of the $n = 1$ state and the instability of the excited states, the equation of the photon and electron in excited states, the equation of the free electron, and photon which predict the wave particle duality behavior of particles and light. The current and charge density functions of the electron may be directly physically interpreted. For example, spin angular momentum results from the motion of negatively charged mass moving systematically, and the equation for angular momentum, $\mathbf{r} \times \mathbf{p}$, can be applied directly to the wave function (a current density function) that describes the electron. The magnetic moment of a Bohr magneton, Stern Gerlach experiment, g factor, Lamb shift, resonant line width and shape, selection rules, correspondence principle, wave particle duality, excited states, reduced mass, rotational energies, and momenta, orbital and spin splitting, spin-orbital coupling, Knight shift, and spin-nuclear coupling, and elastic electron scattering from helium atoms, are derived in closed form equations based on Maxwell's equations. The calculations agree with experimental observations.

In contrast to the failure of the Bohr theory and the nonphysical, adjustable-parameter approach of quantum mechanics, multielectron atoms [4, 7] and the nature of the chemical bond [5, 7] are given by exact closed-form solutions containing fundamental constants only. Using the nonradiative wave equation solutions that describe each bound electron having conserved momentum and energy, the radii are determined from the force balance of the electric, magnetic, and centrifugal forces that correspond to the minimum of energy of the atomic or ionic system. The ionization energies are then given by the electric and magnetic energies at these radii. The spreadsheets to calculate the energies from exact solutions of one through twenty-electron atoms are available from the internet [40]. For 400 atoms and ions the agreement between the predicted and experimental results are remarkable.

Section 92

Pages 29-30 of the Souw Appendix contains the following additional errors in analysis:

> This will now be mathematically proven by the Examiner in a rigorous manner. As recited in Ref. [3] already cited by the Examiner in the previous Appendix, and also in [6] as a new/independent reference (in order to convince Applicant that this Pauli matrix formulation is truly an <u>elementary</u> concept generally known to those <u>ordinary skilled</u> in the art), the Pauli spin operators are defined as (with ***bold italics*** denoting operators): ***S***$_X$= _/2 ***ó***$_X$, ***S***$_y$=_/2 ***ó***$_y$, ***S***$_Z$= _/2 ***ó***$_X$, and ***S***^{2}=_^{2}/4 ***ó***^{2}, with the Pauli spin matrices ***ó***$_X$, ***ó***$_y$, ***ó***$_Z$, and ***S***^{2} conventionally defined as
>
> ó$_X$ =0 1 ó$_y$= 0 -i ó$_Z$ = 1 0 and ó^2 = ó$_X{}^2$ + ó$_y{}^2$ + ó$_Z{}^2$
>
> 1 0 i 0 0 -1
>
> These Pauli spin matrices **ó** (the **bold** print denotes its vector character) <u>are not to be confused</u> with the unspecified spin variable a used by McQuarrie in Eqs. 8-46. The latter will not be further used, because it has not been (and cannot be, or does not need to be) further specified, and its role has 'been adequately taken over by the vectorial properties of the Pauli spin vectors **á** and **â**. Applying these operators to McQuarrie's spin functions á(ó) and â(ó), which are now conveniently and conventionally represented by á(ó)> **á**=[1,0] and â(ó) > **â**=[0,1], both defined as <u>column vectors</u> and both are eigenfunctions of both **ó**^{2} and ó$_Z$, we easily obtain in terms of rigorous undergraduate mathematics:
>
> ***S***$_Z$**á** = _/2 **ó**$_Z$**á** = + _/2 **á** ; ***S***$_Z$ **â ó**$_Z$**â** = -_/2 **â** ;and

S² **á**= _²/4 ó² **á** = _²/4 (1+1+1) **á** = 3 _²/4 **á** : as well as **S²** **â**= _²/4 ó² **â** = _²/4 (1+1+1) **â**

The mathematical relations derived above are in complete agreement with the properties of McQuarrie's spin functions as defined in Eq.8-43. It has been thus proven that Applicant has misunderstood and misrepresented his own cited McQuarrie reference [1], as well as the conventional QM that traditionally makes use of Pauli spin matrices [3, 6].

Applicant does not follow the incorrect approach of SQM. Rather, he correctly solves the electron to give physical predictions that match the observations of the Stern Gerlach experiment. The object is to solve the physical problem correctly, not to follow in the deep rut of SQM mathematics that leads to the wrong physical solution. That the electron is solved correctly by Applicant using physical laws is confirmed by the fact that it is predictive. For example, Applicant's solution predicts the g factor, which is missed entirely by the Examiner's Pauli spin vectors.

In CQM, the g factor is given by a simple close-formed equation with fundamental constants only that is easily derived from the Poynting Power Theorem using the condition of conservation of angular momentum for the spin-flip transition.

ELECTRON g FACTOR

Conservation of angular momentum of the orbitsphere permits a discrete change of its "kinetic angular momentum" $(\mathbf{r} \times m\mathbf{v})$ by the applied magnetic field of $\frac{\hbar}{2}$, and concomitantly the "potential angular momentum" $(\mathbf{r} \times e\mathbf{A})$ must change by $-\frac{\hbar}{2}$.

$$\Delta\mathbf{L} = \frac{\hbar}{2} - \mathbf{r} \times e\mathbf{A} \tag{3}$$

$$= \left[\frac{\hbar}{2} - \frac{e\phi}{2\pi}\right]\hat{z} \tag{4}$$

In order that the change of angular momentum, $\Delta\mathbf{L}$, equals zero, ϕ must be $\Phi_0 = \frac{h}{2e}$, the magnetic flux quantum. The magnetic moment of the electron is parallel or antiparallel to the applied field only. During the spin-flip transition, power must be conserved. Power flow is governed by the Poynting power theorem,

$$\nabla \bullet (\mathbf{E} \times \mathbf{H}) = -\frac{\partial}{\partial t}\left[\frac{1}{2}\mu_o \mathbf{H} \bullet \mathbf{H}\right] - \frac{\partial}{\partial t}\left[\frac{1}{2}\varepsilon_o \mathbf{E} \bullet \mathbf{E}\right] - \mathbf{J} \bullet \mathbf{E} \tag{5}$$

Eq. (6) gives the total energy of the flip transition which is the sum of the energy of reorientation of the magnetic moment (1st term), the magnetic energy (2nd term), the electric energy (3rd term), and the dissipated energy of a fluxon treading the orbitsphere (4th term), respectively,

$$\Delta E_{mag}^{spin} = 2\left(1 + \frac{\alpha}{2\pi} + \frac{2}{3}\alpha^2\left(\frac{\alpha}{2\pi}\right) - \frac{4}{3}\left(\frac{\alpha}{2\pi}\right)^2\right)\mu_B B \tag{6}$$

$$\Delta E_{mag}^{spin} = g\mu_B B \tag{7}$$

where the stored magnetic energy corresponding to the $\frac{\partial}{\partial t}\left[\frac{1}{2}\mu_o \mathbf{H} \bullet \mathbf{H}\right]$ term increases, the stored electric energy corresponding to the $\frac{\partial}{\partial t}\left[\frac{1}{2}\varepsilon_o \mathbf{E} \bullet \mathbf{E}\right]$ term increases, and the $\mathbf{J} \bullet \mathbf{E}$ term is dissipative. The spin-flip transition can be considered as involving a magnetic moment of g times that of a Bohr magneton. The g factor is redesignated the fluxon g factor as opposed to the anomalous g factor. Using $\alpha^{-1} = 137.03603(82)$, the calculated value of $\frac{g}{2}$ is $\mathbf{1.001\ 159\ 652\ 137}$. The experimental value [1] of $\frac{g}{2}$ is $\mathbf{1.001\ 159\ 652\ 188(4)}$.

References for this section:

1. R. S. Van Dyck, Jr., P. Schwinberg, H. Dehmelt, "New high precision comparison of electron and positron g factors", Phys. Rev. Lett., Vol. 59, (1987), p. 26-29.

Section 93

Examiner Souw further errs in his analysis appearing on pages 30-31 of his Appendix:

> (c.4) Fourthly, on top of his misunderstanding, Applicant also has misrepresented his own McQuarrie reference by presenting Y0,0 in place of McQuarrie's Y _,± spin functions, thus leaving an incomplete set of angular momentum eigenfunctions YL,m(è,ö) with L?1 by excluding Y0,0. It is to be emphasized, McQuarrie's *formal* Y _,± is not (and never can be; therefore McQuarrie's stress on "formal") a solution of the angular

momentum eigenvalue equation, as incorrectly assumed by Applicant by misrepresenting it as $Y_{0,0}$. McQuarrie's $Y_{\_,\pm\_}$ is purely formal, and can never be a true or actual angular momentum eigenfunction, $Y_{L,m}$, in which both L and m must be integers, as generally known in the art (see also McQuarrie [1], Eq.6-101 for one-electron atom as well as Eq.6-61 for a diatomic molecule). As generally known in the art, by formally denoting the spin function with $Y_{\_,\pm\_}$, McQuarrie's set of angular momentum eigenfunctions still includes the zero orbital eigenfunction, $Y_{0,0}$. As such, McQuarrie's set of orbital eigenfunctions remains intact as a complete set of eigenfunctions, as it must always be. Obviously, Applicant's set of orbital eigenfunctions fails to comply with his own reference [1], and furthermore, violates a fundamental law of mathematics.

Again, Applicant is NOT following an INCORRECT approach.

Specifically, in response to the Examiner's statement that "McQuarrie's *formal* $Y_{\_,\pm\_}$ is not (and never can be; therefore McQuarrie's stress on "formal") a solution of the angular momentum eigenvalue equation, as incorrectly assumed by Applicant by misrepresenting it as $Y_{0,0}$. McQuarrie's," Applicant does not assert that the Y1/2 function is a solution of the angular momentum eigenvalue equation. Applicant solves for the spin function by applying physics to the following constraints on the current. From Chp. 1 Mills GUT (Ref. #1):

Stern-Gerlach-Experiment Boundary Conditions

It is known from the Stern-Gerlach experiment that a beam of silver atoms is split into two components when passed through an inhomogeneous magnetic field. This implies that the electron is a spin 1/2 particle with an intrinsic angular momentum in the direction of the applied field (spin axis) of $\pm\frac{\hbar}{2}$, and the magnitude of the angular momentum vector which precesses about the spin axis is $\sqrt{\frac{3}{4}}\hbar$. Furthermore, the magnitude of the splitting implies a magnetic moment of μ_B, a full Bohr magneton, given by Eq. (1.99) corresponding to $\hbar$ of total angular momentum on the axis of the applied field.

The algorithm to generate the $Y_0^{\,0}(\phi,\theta)$ orbitsphere equation of motion of the electron (Eqs. (1.64-1.65)) is developed in this section. It was shown in the Angular Function section that the integral of the magnitude of the angular momentum over the orbitsphere must be constant. The constant is $\hbar$ as given by Eq. (1.57). It is shown in this section that the projection of the intrinsic orbitsphere angular momentum

onto the spin axis is $\pm\frac{\hbar}{2}$, and the projection onto **S**, the axis which precesses about the spin axis, is $\hbar$ with a precessing component in the perpendicular plane of $\sqrt{\frac{3}{4}}\hbar$ and a component on the spin axis of $\pm\frac{\hbar}{2}$. Thus, the mystery of an intrinsic angular momentum of $\pm\frac{\hbar}{2}$ and a total angular momentum in a resonant RF experiment of $\mathbf{L}_z = \hbar$ is resolved since the sum of the intrinsic and spin-axis projection of the precessing component is $\hbar$. The Stern-Gerlach experiment implies a magnetic moment of one Bohr magneton and an associated angular momentum quantum number of 1/2. Historically, this quantum number is called the spin quantum number, s ($s = \frac{1}{2}$; $m_s = \pm\frac{1}{2}$), and that designation is maintained.

The electron has a measured magnetic field and corresponding magnetic moment of a Bohr magneton and behaves as a spin 1/2 particle or fermion. For any magnetic field, the solution for the corresponding current from Maxwell's equations is unique. Thus, the electron field requires a unique current according to Maxwell's equations. Several boundary conditions must be satisfied, and the orbitsphere equation of motion for ℓ = 0 is solved as a boundary value problem. The boundary conditions are:

(1) each infinitesimal point (position) on the orbitsphere comprising a charge- (mass)-density element must have the same angular and linear velocity given by Eqs. (1.55) and (1.56), respectively;

(2) according to condition 1, every such infinitesimal point must move along a great circle and the current-density distribution must be uniform;

(3) the electron magnetic moment must align completely parallel or antiparallel with an applied magnetic field in agreement with the Stern-Gerlach experiment;

(4) according to condition 3, the projection of the intrinsic angular momentum of the orbitsphere onto the z-axis must be $\pm\frac{\hbar}{2}$, and the projection into the transverse plane must be $\pm\frac{\hbar}{4}$ to achieve the spin 1/2 aspect;

(5) the Larmor excitation of the electron in the applied magnetic field must give rise to a component of electron spin angular

momentum that precesses about the applied magnetic field such that the contribution along the z-axis is $\pm\frac{\hbar}{2}$ and the projection onto the orthogonal axis which precesses about the z-axis must be $\pm\sqrt{\frac{3}{4}}\hbar$;

(6) due to conditions 4 and 5, the angular momentum components corresponding to the current of the orbitsphere and that due to the Larmor precession must rise to a total angular momentum on the applied-field axis of $\pm\hbar$;

(7) due to condition 6, the precessing electron has a magnetic moment of a Bohr magneton, and

(8) the energy of the transition of the alignment of the magnetic moment with an applied magnetic field must be given by Eqs. (1.194-1.195) wherein the g factor and Bohr magneton factors are due to the extended-nature of the electron such that it links flux in units of the magnetic flux quantum and has a total angular momentum on the applied-field axis of $\pm\hbar$.

The resulting current is uniform corresponding to Y00 that gives rise to spin angular momentum and is in agreement with all measurements of this phenomenon. The spin energy and angular momentum are calculated classically and are given in Section 88 above. The constant spin function can be modulated with a spherically and time-harmonic charge-density wave. The constant function, the modulation function, and the constant function plus the modulation function are solutions of the two-dimensional wave equation plus time. The corresponding orbital energies are given in Section 88 above.

Section 94

Examiner Souw's further argues on pages 31-32 of his Appendix that:

(c.5) Fifthly, what is correctly meant by McQuarrie with his wavefunction involving á and â is well known in the art as Pauli wavefunctions represented by 2-dimensional eigenvector with components $ø^+$ and $ø^-$ [3, 7, 8], each of which being an independent function of (***r***,t), i.e., $ø^+ = ø_{100\_}$ (***r***,t), and $ø^- = ø_{100-\_}$(***r***,t), as presented by McQuarrie in Eq.8-51 on pg.301. These two independent and mutually orthogonal eigenfunctions are most conveniently written in the form of column vector components $ø^+$

= **á**$Y_{L,m}$(r,ö)$R_{n,L}$(r) and ø$^-$ = **â**$Y_{L,m}$(r,ö)$R_{n,L}$(r), as recited in Eq.1 of the Examiner's own work [3], as well as in Ref.[7] (Eqs.5.42-47), where **á**=[1,0]=column vector, **â**=[0, 1]=column vector, $Y_{L,m}$(r,ö) is the conventional orbital angular momentum eigenfunction (=spherical harmonics, <u>with L=0 included</u> (see [1] Eq.6-76 on pg.215), and $R_{n,L}$(r) is the conventional radial function (=associated Laguerre function, in case of hydrogen wave function; see [1] Eq.6-102 on pg.223). The two eigenvector components ø$^+$ = **á**$Y_{L,m}R_{n,L}$ and ø$^-$ = **â**$Y_{L,m}R_{n,L}$ are generally known in the art as Pauli eigenvectors (components) [3, 7].

Mathematically they are equivalent to McQuarrie's Eq.8-51, in which McQuarrie's spin functions á(ó) and â(ó) have been specifically represented by the Pauli spin vectors **á** and **â**, both satisfying the orthogonality condition as given by McQuarrie in Eq.4-46, since **á?â**=0=**â?á**, **á?á**=1=**â?â**, ?dó=1. and both also satisfying McQuarrie's eigenvalue equations 8-43.

It has been thus shown, that McQuarrie Ref. [1] perfectly agrees with the Examiner's refutation as presented in the previous Appendix as well as in Examiner's Ref.[3], whereas Applicant's GUT wavefunction does not comply with his own cited reference [1], while also violating fundamental laws of mathematics and physics. <u>Note</u>: Ref.[7, 8] are new citations, to show that the Pauli wave functions, ø$^+$ and ø$^-$, are well-known and widely used in the art, as equivalents to McQuarrie's. Thus, applicant's refutation of conventional QM stems from his own misunderstanding of the subject matter, including his own cited reference [1].

The Examiner has captured the argument of SQM with its rules and representations of spin in zero dimensions, but the results are not predictive and are not in agreement with observations, as noted previously. Applicant's objective was to physically solve for real current functions that match the data (not the nonsense of current in zero-dimensional space). Applicant's solutions are predictive and match the observations. That they are different from the old formalisms (such as the Pauli spin vectors **á** and **â**, both satisfying the orthogonality condition) is expected since the old approach is NOT CORRECT.

<u>Section 95</u>

Examiner on Souw further argues on Appendix page 32:

> This is not an *a priori* standpoint taken by the Examiner, as alleged by Applicant, but has been conclusively drawn from the unprecedented amount of self-contradictory and erroneous arguments of record presented by Applicant that show Applicant's complete misunderstanding of the QM.

Applicant understands SQM very well to the point that he appreciates and admits that it can not possibly be correct. Even the founders of quantum mechanics argued this as pointed out in Applicant's papers:

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.
106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted.
102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One-Through Twenty-Electron Atoms", Physics Essays, submitted.
94. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", Physics Essays, in press.
80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.
58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.
21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

Applicant was fortunate in that he had a quantum mechanics professor who was honest and taught that "SQM should be used as a tool, it is the best we can do at the moment, but it has many problems including the fact that it is not based on physical laws learned in prior courses and is not easily interpreted in terms of physical reality." Little did he know at the time that one of his students would take an initiative to his

prediction that "some day someone will replace it with the correct theory of atomic physics."

Section 96

Examiner Souw continues on page 32 of his Appendix, erroneously arguing:

> The Examiner also continues to disagree with applicant's repeated recitation (and "refutation"!) of Dirac's formulation of particle with spin _ in the form of a 4-vector (see e.g., [9] & Drell) , which is known in the art as being a natural (i.e., relativistic) extension of the 2-dimensional Pauli vector wave functions to 4-dimensional Dirac vectors that automatically represents anti-particles. Given that applicant has misunderstood Dirac's relativistic formulation, applicant's argument regarding this issue is unpersuasive.

The Dirac equation is wrong, as pointed out above and in the paper

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted:

II. Quantum Electrodynamics (QED)

Quantum mechanics failed to predict the results of the Stern-Gerlach experiment which indicated the need for an additional quantum number. In quantum mechanics, the spin angular momentum of the electron is called the "intrinsic angular momentum" since no physical interpretation exists. (Currents corresponding to the observed magnetic field of the electron can not exist in one dimension of four dimensional spacetime where Ampere's law and the intrinsic special relativity determine the corresponding unique current.) The Schrödinger equation is not Lorentzian invariant in violation of special relativity. The Schrödinger equation also misses the Lamb shift, the fine structure, and the hyperfine structure completely, and it is not stable to radiation. Quantum electrodynamics was proposed by Dirac in 1926 to provide a generalization of quantum mechanics for high energies in conformity with the theory of special relativity and to provide a consistent treatment of the interaction of matter with radiation. But, it does not bridge the gap between quantum mechanics and special relativity. From Weisskopf [19], "Dirac's quantum electrodynamics gave a more consistent derivation of the results of the correspondence principle, but it also brought about a number of new and serious difficulties." Quantum electrodynamics; (1) does not explain nonradiation of bound electrons; (2) contains an internal inconsistency with special relativity regarding the classical electron radius—the electron mass corresponding to its electric energy is infinite; (3) it admits solutions of negative rest mass and negative kinetic energy; (4) the interaction of the electron with the predicted zero-point field fluctuations leads to infinite kinetic energy and infinite electron mass; (5) Dirac used the unacceptable states of negative mass for the description of the

vacuum; yet, infinities still arise. Dirac's postulated relativistic wave equation gives the inescapable result of a cosmological constant that is at least 120 orders of magnitude larger than the best observational limit due to the unacceptable states of negative mass for the description of the vacuum as discussed previously [2-7, 9-10][26]. The negative mass states further create an absolute "ether"-like frame in violation of special relativity which was disproved by the Michelson-Morley experiment.

In retrospect, Dirac's equation which was postulated to explain spin relies on the unfounded notions of negative energy states of the vacuum, virtual particles, and gamma factors; thus, it can not be the correct description of a bound electron even though it gives an addition quantum number interpreted as corresponding to the phenomenon of electron spin. Ironically, it is not even internally consistent with respect to its intent of being in accord with special relativity. In addition to violating Maxwell's equation with respect to stability to radiation wherein Maxwell's equations are implicit and the internal inconsistency with special relativity regarding the classical electron radius and states of negative rest mass and negative kinetic energy as given by Weisskopf [19], the Dirac equation violates Einstein causality and locality and conservation of energy as shown by the Klein Paradox discussed previously [2, 4, 7][27]. Furthermore, everyday observation demonstrates that causality and locality always hold. Einstein also argued that a probabilistic versus deterministic nature of atomic particles leads to disagreement with special relativity. In fact, the nonlocality result of the Copenhagen interpretation violates causality as shown by Einstein, Podolsky, and Rosen (EPR) in a classic paper [22] that presented a paradox involving instantaneous (faster-than-light) communication between particles called "spooky action at a distance" which led them to conclude that quantum mechanics is not a complete or correct theory. The implications of the EPR paper and the exact Maxwellian predictions of "spooky

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[26] The Rutherford experiment demonstrated that even atoms are comprised of essentially empty space [20]. Zero-point field fluctuations, virtual particles, and states of negative energy and mass invoked to describe the vacuum are nonsensical and have no basis in reality since they have never been observed experimentally and would correspond to an essentially infinite cosmological constant throughout the entire universe including regions of no mass. As given by Waldrop [21], "What makes this problem into something more than metaphysics is that the cosmological constant is observationally zero to a very high degree of accuracy. And yet, ordinary quantum field theory predicts that it ought to be enormous, about 120 orders of magnitude larger than the best observational limit. Moreover, this prediction is almost inescapable because it is a straightforward application of the uncertainty principle, which in this case states that every quantum field contains a certain, irreducible amount of energy even in empty space. Electrons, photons, quarks—the quantum field of every particle contributes. And that energy is exactly equivalent to the kind of pressure described by the cosmological constant. The cosmological constant has accordingly been an embarrassment and a frustration to every physicist who has ever grappled with it."

[27] Oskar Klein pointed out a glaring paradox implied by the Dirac equation which was never resolved [23]. "Electrons may penetrate an electrostatic barrier even when their kinetic energy, $E - mc^2$ is lower than the barrier. Since in Klein's example the barrier was infinitely broad this could not be associated with wave mechanical tunnel effect. It is truly a paradox: Electrons too slow to surpass the potential, may still only be partially reflected. ...Even for an infinitely high barrier, i.e. $r_2 = 1$ and energies $\approx 1\ MeV$, (the reflection coefficient) R is less than 75%! From (2) and (3) it appears that as soon as the barrier is sufficiently high: $V > 2mc^2$, electrons may transgress the repulsive wall—seemingly defying conservation of energy. ...Nor is it possible by way of the positive energy spectrum of the free electron to achieve complete Einstein causality."

action" and "entanglement" experiments, incorrectly interpreted in the context of quantum mechanic, are given in Chp. 37 of Ref. [7].

In 1947, contrary to Dirac's predictions, Lamb discovered a $1000\ MHz$ shift between the $^2S_{1/2}$ state and the $^2P_{1/2}$ state of the hydrogen atom [24]. This so called Lamb Shift marked the beginning of modern quantum electrodynamics. In the words of Dirac [25], "No progress was made for 20 years. Then a development came initiated by Lamb's discovery and explanation of the Lamb Shift, which fundamentally changed the character of theoretical physics. It involved setting up rules for discarding ...infinities..." Renormalization is presently believed to be required of any fundamental theory of physics [26]. However, dissatisfaction with renormalization has been expressed at various times by many physicists including Dirac [27] who felt that, "This is just not sensible mathematics. Sensible mathematics involves neglecting a quantity when it turns out to be small—not neglecting it just because it is infinitely great and you do not want it!"

Albeit, the Dirac equation did not predict the Lamb shift or the electron g factor [24, 28-29], its feature of negative-mass states of the vacuum gave rise to the postulates of QED that has become a center piece of quantum mechanics to explain these and other similar observations. One of QED's seminal aspects of renormalization which was subsequently grafted into atomic theory was a turning point in physics similar to the decision to treat the electron as a point-particle-probability wave, a point with no volume with a vague probability wave requiring that the electron have an infinite number of positions and energies including negative and infinite energies simultaneously. The adoption of the probabilistic versus deterministic nature of atomic particles violates all physical laws including special relativity with violation of causality as pointed out by Einstein [22] and de Broglie [30]. Consequently, it was rejected even by Schrödinger [31].

Pure mathematics took the place of physics when calculating subtle shifts of the hydrogen atomic energy levels. Moreover, in QED, the pure mathematics approach has been confused with physics to the point that virtual particles are really considered as causing the observable. The justification for the linkage is often incorrectly associated with the usage of series expansion and variational methods to solve problems based on physical laws. But, series expansion of an equation based on a physical action or variation of a physical parameter of the equation versus the fabrication of an action based on fantastical untestable constructs that are represented by a series are clearly different. For example, the motion of a pendulum can be solved exactly in terms of an elliptic integral using Newtonian mechanics. Expansion of the elliptic integral in a power series and ignoring negligible terms in the series versus setting up of arbitrary rules for *discarding infinities* are clearly not the same. Furthermore, inventing virtual particles that have an action on space, and subsequently on an electron, versus expanding terms in the energy equation due to a gravitating body causing a gravitational field and thus an action on the pendulum are very different. In QED, virtual particles are not merely a sustitutional or expansion variable. They are really considered as causing the observable.

In a further exercise of poor science, virtual-particle-based calculations are even included in the determination of the fundamental constants which are circularly used to calculate the parameter ascribed to the virtual particles. For example, using the electron magnetic moment anomaly in the selection of the best value of the fine structure constant, the CODATA publication [32] reports the use of virtual particles:

"The term A1 is mass independent and the other terms are functions of the indicted mass ratios. For these terms the lepton in the numerator of the mass ratio is the particle under consideration, while the lepton in the denominator of the ratio is the virtual particle that is the source of vacuum polarization that gives rise to the term."

There is no direct evidence that virtual particles exist or that they polarize the vacuum. Even their postulation is an oxymoron.

Throughout the history of quantum theory, wherever there was an advance to a new application, it was necessary to repeat a trial-and -error experimentation to find which method of calculation gave the right answers. Often the textbooks present only the successful procedure as if it followed from first principles and do not mention the actual method by which it was found. In electromagnetic theory based on Maxwell's equations, one deduces the computational algorithm from the general principles. In quantum theory, the logic is just the opposite. One chooses the principle (e.g. phenomenological Hamiltonians) to fit the empirically successful algorithm. For example, we know that it required a great deal of art and tact over decades of effort to get correct predictions out of QED. The QED method of the determination of $(g-2)/2$ from the *postulated* Dirac equation is based on a *postulated* power series of α/π where each *postulated* virtual particle is a source of *postulated* vacuum polarization that gives rise to a *postulated* term which is processed over decades using ad hoc rules to remove infinities from each term that arises from *postulated* scores of *postulated* Feynman diagrams. The solution so obtained using the perturbation series further requires a *postulated* truncation since the series *diverges*. Mohr and Taylor reference some of the Herculean efforts to arrive at g using QED [32]:

"the sixth-order coefficient $A_1^{(6)}$ arises from 72 diagrams and is also known analytically after nearly 30 years of effort by many researchers [see Roskies, Remiddi, and Levine (1990) for a review of the early work]. It was not until 1996 that the last remaining distinct diagrams were calculated analytically, thereby completing the theoretical expression for $A_1^{(6)}$".

For the right experimental numbers to emerge, one must do the calculation (i.e. subtract off the infinities) in one particular way and not in some other way that appears in principle equally valid. For example, Milonni [33] presents a QED derivation of the magnetic moment of the electron which gives a result of the wrong sign and requires the introduction of an

"upper limit K in the integration over $k=\omega/c$ in order to avoid a divergence."

A differential mass is arbitrarily added, then

"the choice $K = 0.42mc/\hbar$ yields $(g-2)/2 = \alpha/2\pi$ which is the relativistic QED result to first order in α. [...] However, the reader is warned not to take these calculations too seriously, for the result $(g-2)/2 = \alpha/2\pi$ could be obtained by retaining only the first (radiation reaction) term in (3.112) and choosing $K = 3mc/8\hbar$. It should also be noted that the solution $K \cong 0.42mc/\hbar$ of (3.112) with $(g-2)/2 = \alpha/2\pi$ is not unique."

Such an ad hoc nonphysical approach makes incredulous:

" the cliché that QED is the best theory we have!" [34]

or the statement that:

"The history of quantum electrodynamics (QED) has been one of unblemished triumph" [35].

There is a corollary, noted by Kallen: from an inconsistent theory, any result may be derived.

In an attempt to provide some physical insight into atomic problems and starting with the same essential physics as Bohr of e^- moving in the Coulombic field of the proton and the wave equation as modified after Schrödinger, a classical approach was explored which yields a model which is remarkably accurate and provides insight into physics on the atomic level [2-7]. Physical laws and intuition are restored when dealing with the wave equation and quantum mechanical problems. Specifically, a theory of classical quantum mechanics (CQM) was derived from first principles that successfully applies physical laws on all scales. Rather than use the postulated Schrödinger boundary condition: "$\Psi \to 0$ as $r \to \infty$", which leads to a purely mathematical model of the electron, the constraint is based on experimental observation. Using Maxwell's equations, *the classical wave equation is solved with the constraint that the bound $n = 1$-state electron cannot radiate energy*. The electron must be extended rather than a point. On this basis with the assumption that physical laws including Maxwell's equation apply to bound electrons, the hydrogen atom was solved exactly from first principles. The remarkable agreement across the spectrum of experimental results indicates that this is the correct model of the hydrogen atom.

It was shown previously that quantum mechanics does not explain the stability of the atom to radiation [2]; whereas, the Maxwellian approach gives a natural relationship between Maxwell's equations, special relativity, and general relativity. CQM holds over a scale of spacetime of 85 orders of magnitude—it correctly predicts the nature of the universe from the scale of the quarks to that of the cosmos [3]. A review is given by Landvogt [36]. In a third paper, the atomic physical approach was applied to multielectron atoms that were solved exactly disproving the deep-seated view that such exact solutions can not exist according to quantum mechanics. The general solutions for one through twenty-electron atoms are given in Ref [4]. The predictions are in remarkable agreement with the experimental values known for 400 atoms and ions. A fourth paper presents a solution based on physical laws and fully compliant with Maxwell's equations that solves the 26 parameters of molecular ions and molecules of hydrogen isotopes in closed-form equations with fundamental constants only that match the experimental values [5]. In a fifth paper, the

nature of atomic physics being correctly represented by quantum mechanics versus classical quantum mechanics is subjected to a test of internal consistency for the ability to calculate the conjugate observables using the same solution for each of the separate experimental measurements [6]. It is confirmed that the CQM solution is the accurate model of the helium atom by the agreement of predicted and observed conjugate parameters of the free electron, ionization energy of helium and all two electron atoms, ionization energies of multielectron atoms, electron scattering of helium for all angles, and all He I excited states using the same unique physical model in all cases. Over five hundred conjugate parameters are calculated using a unique solution of the two-electron atom without any adjustable parameters to achieve overall agreement to the level obtainable considering the error in the measurements and the fundamental constants in the closed-form equations.

In contrast, the quantum fails utterly. Ad hoc computer algorithms are used to generate meaningless numbers with internally inconsistent and nonphysical models that have no relationship to physics. Attempts are often made to numerically reproduce prior theoretical numbers using adjustable parameters including arbitrary wave functions in computer programs with precision that is often much greater (e.g. 8 significant figures greater) than possible based on the propagation of errors in the measured fundamental constants implicit in the physical problem.

In this sixth paper of a series, rather than invoking renormalization, untestable virtual particles, and polarization of the vacuum by the virtual particles, the results of QED such as the anomalous magnetic moment of the electron, the Lamb Shift, the fine structure and hyperfine structure of the hydrogen atom, and the hyperfine structure intervals of positronium and muonium (thought to be only solvable using QED) are solved exactly from Maxwell's equations to the limit possible based on experimental measurements.

Section 97

Examiner Souw's inconsistent positions are further exposed on pages 32-33 of his Appendix, wherein he states:

> (d) On pg.65, Applicant's argument regarding dphi>inifnity dphi>2pi only reflects Applicant's misunderstanding regarding multi-valued functions. Furthermore, Applicant's wording *"in order not to violate the HUP"* does not make sense to those of ordinary skill in the art, since a constant probability density in all space having dx=inifnity does not violate the HUP at all, but is the manifestation of HUP (both äp=0?äx=? and äx=0?äp=? strictly obey the HUP, äp?äx??). The same conceptual error has been previously discussed in sub-paragraph 6(b). Such a serious misunderstanding of the HUP ultimately disqualifies Applicant's arguments altogether.

With regard to the Examiner's statement that "a constant probability density in all space having dx=inifnity does not violate the HUP at all," it is amazing that he can believe that the single electron is over all space simultaneously and instantaneously and still maintain that physical laws are not violated. The Examiner's inability to even recognize this conundrum, much less resolve it, is symptomatic of the problems with his flawed analysis.

Furthermore, with regard to the case presented in Applicant's paper
80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted, the following relevant passage provides:

> For the n=1 state, $\ell = 0$; thus, **the angular momentum according to the Schrodinger equation is exactly zero—not $\hbar$**. Furthermore, the kinetic energy of rotation K_{rot} is also **zero**. As a consequence, it is internally inconsistent for Feynman to accept the HUP which arises from the Schrodinger equation on the one hand and that the electron obeys the classical Coulomb law and is bound in an inverse squared Coulomb field on the other. Rather than a kinetic energy of $\frac{\hbar^2}{2mr^2}$ which is added to the Coulomb energy of $-\frac{e^2}{r}$ to get the total energy, exactly zero should be added to the Coulomb energy. This is an inescapable nonsensical result which arises from the SE directly, and it can not be saved by incorrectly assigning the angular momentum as $\hbar$ from the uncertainty relationship. Furthermore, the result that L = K_{rot} **= exactly zero violates the HUP making the argument further internally inconsistent.** In addition, applying Eq. (3) to spherical harmonic solutions for Ψ with an exact momentum and energy for a given ℓ in Eqs. (11) and (12), respectively, requires that $\Delta\theta \to \infty$ since $\Delta L = 0$ in the relationship $\Delta L \Delta\theta \geq \frac{\hbar}{2}$. The result $\Delta\theta \to \infty$ is nonsensical. Postulating a linear combination of spherical harmonics is not consistent with a single momentum state and will not save the HUP since the linear combination is not an eigenfunction. Rather it is a wavefunction of a set that is not orthonormal (i.e. it violates QM postulates by not yielding the Kroenecker delta).

The HUP is violated. Using the Examiner's insistence that "dphi>inifnity dphi>2pi only reflects Applicant's misunderstanding regarding multi-valued functions", the insertion of 2pi in the HUP gives

$$\sigma_x \sigma_p \geq \frac{\hbar}{2}$$
$$2\pi 0 \geq \frac{\hbar}{2} \qquad (6)$$
$$0 \geq \frac{\hbar}{2}$$

which is a violation as pointed out by Applicant in the previous Response.

Section 98

Examiner Souw further argues on Appendix page 33 that:

7. Applicant's misunderstanding of the Uncertainty Principle in QM

(a) Unlike the uncertainty of position and linear momentum, there is no äö>? in case of sharply defined angular momentum (äL>0), but only äö>2∂ since äö>? inevitably ends up in being confined within 2∂ due to the multiple values of the angular variable ö. Applicant's confusion in such a simple problem is another evidence for Applicant's misunderstanding of the HUP.

Applicant is confident that there is no understanding SQM, as noted by Feynman, Dirac, and other quantum theoreticians. Furthermore, the Examiner's requirement that L=0 phi=2phi violates the HUP and shows that he has trouble with simple arithmetic, let alone understanding a theory that has defied interpretation for 80 years. See:

F. Laloë, Do we really understand quantum mechanics? Strange correlations, paradoxes, and theorems, Am. J. Phys. 69 (6), June 2001, 655-701.

Section 99

Examiner Souw further errs in his statements on Appendix page 33 that:

(b) Applicant's has failed to remove, or even properly address the Examiner's points of refutation in the previous Appendix. Consequently, said refutation remains in force, and is here re-instated by incorporation, in addition to new proofs of errors and misunderstanding encompassed in Applicant's response(s), to be detailed as follows.

Applicant notes that the problems that the Examiner is having with understanding Applicant's theory is that (1) he is mistaken in his claim that SQM uses physical laws; the mathematics of SQM violates physical laws; and (2) he tries to interpret Applicant's physical approach from the perspective of SQM with the false presumption that this approach in right, even given that SQM is alien to physical laws.

Section 100

Examiner Souw further asserts on Appendix page 33:

> (c) There is no such thing as *"mathematics versus physics"* as alleged by Applicant; but rather, the two aspects always develop hand-in-hand (see section 5a(a) above). As known in the art, besides experimental evidence, physics is built on rigorous mathematics.

The Examiner's point does not resolve anything. There is certainly a distinction between pure mathematics and physics. There is an infinite body of mathematics that has no connection to real world physics. Mathematics is merely a tool to model physics. SQM is pure mathematics and curve-fitting. It is not predictive and has no physical meaning. SQM only produces numbers that are forced to match experimental numbers when the adjustable parameters are varied accordingly.

Section 101

Examiner Souw further states on pages 33-34 of his Appendix that:

> (d) Applicant's argument regarding the Examiner's "bias by QM" is inappropriate because it is the Examiner's job to understand the scientific principles behind an invention by using tools made available to him by conventionally accepted science. QM is one of those tools that has been conventionally and objectively accepted by the scientific community. The Examiner plays no role in the scientific community's acceptance of QM.

Applicant is entitled to fair, competent, and unbiased evaluation of his application under the U.S. patent laws. Even if it is not willful intent, the Examiner's lifelong education in the field of SQM has incapacitated him from evaluating Applicant's invention, which is based on physical laws. The mastering of SQM requires a certain "suspension of belief" in physics. The Examiner's biased and corrupted myopic view is evident as pointed out in Section 99 above. Applicant believes a fair evaluation of his

novel hydrogen technologyl requires the replacement of the Examiner of Record with one educated in physical laws. Perhaps, an engineer rather than a SQM theoretician, since Applicant's theory based on physical laws teaches against the nonphysical SQM.

<u>Section 102</u>

Examiner Souw further argues on Appendix page 34 that:

> In each and every instance as evidenced by applicant's response throughout the entire prosecution history of this application, the applicant uses the competitor argument whenever his theory is refuted by any individual who provides sound mathematical and physical arguments based on conventionally accepted science such as QM to disprove applicant's mathematically and physically flawed theory. However, it is must be emphasized that QM is not a competing theory but a conventionally accepted theory. Applicant has not provided any solid evidence that QM is flawed. All of applicant's previous arguments regarding the deficiencies of QM and attempts to disprove QM have been refuted by the Examiner in the previous and current arguments of record.

Applicant has presented many examples where SQM is flawed, as have many other noted theoreticians, including the most prominent founders of SQM as pointed out in the following papers.

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physics Essays, submitted.
106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Annales de la Fondation Louis de Broglie, submitted.
102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One- Through Twenty-Electron Atoms", Physics Essays, submitted.
94. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", Physics Essays, in press.
80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.
58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.
21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.

5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, *The Grand Unified Theory of Classical Quantum Mechanics*, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2005 Edition posted at www.blacklightpower.com.

The Examiner just chooses to ignore them.

That others use what is available even though SQM is not right does not preclude the possibility that the correct theory can or will not be found. Furthermore, the results of CQM are unmatched by any version of SQM over its entire history. CQM gives closed-formed equations containing fundamental constants for 100's of predictions that match the experimental values with remarkable agreement, as discussed in Sections 54-55 and 69-70 above. Not a single, predictive internally consistent equation based on physics has ever been given by SQM, as discussed in the papers cited above.

Section 103

On page 34 of the Souw Appendix, the Examiner further asserts that:

> Regarding Applicant's request to have his applications examined by an Examiner who is "skilled in Maxwell equations", the MPEP states that a rejection may rely upon facts within the examiner's own/personal knowledge or other PTO employee(s); see MPEP 2 144.03(C), 37 CFR 1.1 04(c)(3) and 37 CFR 1.1 04(dX2). In this regard, the Examiner's skill in the pertinent art, both theoretical and experimental, is documented in his publication [10]. Note, the cited work has been accomplished by the Examiner 17 years ago, such that a "conflict of interest" argument is without merit.

First, it is obvious that the Examiner has not studied Applicant's "conflict of interest argument,' as his comments are non responsive. Further, it is clear that the Examiner does not have the right background when he argues that he is applying physical laws on the one hand, and then uses the HUP on the other.

The Uncertainty Principle [23. D. A. McQuarrie, *Quantum Chemistry*, University Science Books, Mill Valley, CA, (1983), pp. 135-140] is

$$\sigma_x \sigma_p \geq \frac{\hbar}{2} \tag{6}$$

where σ_x and σ_p are given by

$$\sigma_x^2 = \int \psi^* \left(\hat{X} - \langle x \rangle\right)^2 \psi dx \tag{7}$$

$$\sigma_p^2 = \int \psi^* \left(\hat{P} - \langle p \rangle\right)^2 \psi dx \tag{8}$$

The definition of the momentum operator in a *one dimensional* system is [23]

$$\hat{P}_x = -i\hbar \frac{d}{dx} \tag{9}$$

and the position operator is

$$\hat{X} = x \qquad (\text{multiply by x}) \tag{10}$$

The Uncertainty Principle is also expressed as

$$\Delta x \Delta p \geq \frac{\hbar}{2} \tag{3}$$

It is not founded on an argument about the measurement of conjugate parameters; rather it is based on the premise that reality is not definite or has no state until it is measured and the measurement device becomes entangled with the object being measured and is inseparable from it.

The Examiner states that SQM is based on physical laws. This is absolutely not true. The Examiner simply must face the reality of his belief in the Heisenberg Uncertainty Principle, requiring that all atomic objects have no physical form, that spooky action is implicit in all atomic interactions (faster than light action at a distance is predicted for all events), that atomic objects are everywhere at once (infinite number of positions and energies simultaneously, including ones of positive or negative infinity at the same instant in time), that contradictory statement must be taken as true simultaneously, that there is no causality, that time is quantized rather than continuous, even though it is disproved by the Hubble images, that every point in space contains an infinity of virtual particles that pop into and out of existence constantly, but are never observed and require a cosmological constant 120 orders of magnitude higher than the highest possible value observed, and that there are many more consequences such as infinities, Klein paradox, other paradoxes, etc. that arise.

The Examiner insists that SQM is based on physical laws. Physical laws are exact experimentally confirmed relationships. The Heisenberg Uncertainty Principle

does not permit exact relationships. Thus, the following laws that are exact relationships without any uncertainty violate the Heisenberg Uncertainty Principle:

- Conservation of linear and angular momentum
- Conservation of energy
- The relativistic invariance of charge

Planck's equation

$$E = \hbar\omega = h\frac{\omega}{2\pi} = h\nu = hf = h\frac{c}{\lambda} \tag{2.75}$$

$\mathbf{p}$, the momentum of the photon

$$\mathbf{p} = mc = \frac{E_{h\nu}}{c} \tag{2.77}$$

where c is the velocity of light, so that

$$M\mathbf{V} = M(\mathbf{V} + \mathbf{v}) + \frac{E_{h\nu}}{c} \tag{2.78}$$

And, the recoil momentum is

$$M\mathbf{v} = -\frac{E_{h\nu}}{c} \tag{2.79}$$

Thus, the recoil energy is given by

$$E_R = \frac{E_{h\nu}^2}{2Mc^2} \tag{2.80}$$

The Schwarzschild metric

$$d\tau^2 = \left(1 - \frac{2Gm_0}{c^2 r}\right)dt^2 - \frac{1}{c^2}\left[\left(1 - \frac{2Gm_0}{c^2 r}\right)^{-1} dr^2 + r^2 d\theta^2 + r^2 \sin^2\theta d\phi^2\right] \tag{24.2}$$

Newton's Law of Gravitation for $\frac{r_g}{r_\alpha} << 1$

$$\mathbf{F} = \frac{Gm_1m_2}{r^2} \tag{24.3}$$

where G is the Newtonian gravitational constant.

Maxwell's Equations

$$\nabla \times \mathbf{E} = -\frac{\partial \mu_o \mathbf{H}}{\partial t} \tag{24.4}$$

$$\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \varepsilon_o \mathbf{E}}{\partial t} \tag{24.5}$$

$$\nabla \bullet \varepsilon_o \mathbf{E} = \rho \tag{24.6}$$

$$\nabla \bullet \mu_o \mathbf{H} = 0 \tag{24.7}$$

Maxwell's Integral Laws in Free Space:

Ampere's Law

$$\oint_C \mathbf{H} \bullet d\mathbf{s} = \int_S \mathbf{J} \bullet d\mathbf{a} + \frac{d}{dt}\int_S \varepsilon_0 \mathbf{E} \bullet d\mathbf{a} \tag{24.8}$$

Faraday's Law

$$\oint_C \mathbf{E} \bullet d\mathbf{s} = -\frac{d}{dt}\int_S \mu_0 \mathbf{H} \bullet d\mathbf{a} \tag{24.9}$$

The Poynting power theorem:

$$\nabla \bullet (\mathbf{E} \times \mathbf{H}) = -\frac{\partial}{\partial t}\left[\frac{1}{2}\mu_o \mathbf{H} \bullet \mathbf{H}\right] - \frac{\partial}{\partial t}\left[\frac{1}{2}\varepsilon_o \mathbf{E} \bullet \mathbf{E}\right] - \mathbf{J} \bullet \mathbf{E} \tag{24.10}$$

Newtonian mechanics for $v << c$:

$$\mathbf{F} = \frac{d\mathbf{p}}{dt} = \frac{d(m\mathbf{v})}{dt} = m\frac{d\mathbf{v}}{dt} = m\mathbf{a} \tag{24.11}$$

$$T = \frac{1}{2}mv^2 \tag{24.12}$$

Special Relativity that applies when v approaches c:

$$E = mc^2 \tag{24.13}$$

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{24.14}$$

$$l = l_o\sqrt{1 - \frac{v^2}{c^2}} \tag{24.15}$$

$$t = \frac{t_0}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{24.16}$$

where the subscript denotes the value in the rest frame.

The relationship between the speed of light, c, and the permittivity of free space, ε_0, and the permeability of free space, μ_0

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} \tag{24.28}$$

The fine structure constant relationship

$$\alpha = \frac{1}{4\pi}\sqrt{\frac{\mu_0}{\varepsilon_0}}\frac{e^2}{\hbar} = \frac{1}{2}\frac{\sqrt{\frac{\mu_0}{\varepsilon_0}}}{\frac{h}{e^2}} = \frac{\mu_0 e^2 c}{2h} \tag{24.29}$$

The relationship for the radiation resistance of free space, η.

$$\eta = \sqrt{\frac{\mu_0}{\varepsilon_0}} = 4\pi\alpha\frac{\hbar}{e^2} \tag{24.30}$$

The provision of a limiting speed of c for the propagation of any wave, including gravitational and electromagnetic waves and expanding spacetime.

The transition lifetime, τ, of the electric multipole moment given by

$$Q_{lm} = \frac{3}{\ell + 3} e (r_n)^{\ell} \tag{24.34}$$

of [1]

$$\tau = \frac{energy}{power}$$

$$\tau = \frac{[\hbar\omega]}{\left[\frac{2\pi c}{[(2l+1)!!]^2}\left(\frac{l+1}{l}\right)k^{2l+1}\left|Q_{lm} + Q'_{lm}\right|^2\right]} = \frac{1}{2\pi}\left(\frac{h}{e^2}\right)\sqrt{\frac{\varepsilon_0}{\mu_0}}\frac{[(2l+1)!!]^2}{2\pi}\left(\frac{l}{l+1}\right)\left(\frac{l+3}{3}\right)^2\frac{1}{(kr_n)^{2l}\omega}.$$

(24.35)

Furthermore, in addition to failing to provide for the stability of the hydrogen atom, the Heisenberg Uncertainty Principle has been directly disproved by many observations such as those of the Hubble space telescope, interferometry experiments, and the nonexistence of an infinite cosmological constant as detailed in Applicant's paper

80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted.

as well as the following papers:

107. R. L. Mills, "Maxwell's Equations and QED: Which is Fact and Which is Fiction", Physica Scripta, submitted.
106. R. L. Mills, "Exact Classical Quantum Mechanical Solution for Atomic Helium Which Predicts Conjugate Parameters from a Unique Solution for the First Time", Progress of Physics, submitted.
102. R. L. Mills, "Exact Classical Quantum Mechanical Solutions for One- Through Twenty-Electron Atoms", Physics Essays, submitted.
94. R. L. Mills, "The Nature of the Chemical Bond Revisited and an Alternative Maxwellian Approach", Physics Essays, in press.
58. R. L. Mills, "Classical Quantum Mechanics", Physics Essays, in press.
21. R. Mills, "The Grand Unified Theory of Classical Quantum Mechanics", Int. J. Hydrogen Energy, Vol. 27, No. 5, (2002), pp. 565-590.
17. R. Mills, "The Nature of Free Electrons in Superfluid Helium--a Test of Quantum Mechanics and a Basis to Review its Foundations and Make a Comparison to Classical Theory", Int. J. Hydrogen Energy, Vol. 26, No. 10, (2001), pp. 1059-1096.
5. R. Mills, "The Hydrogen Atom Revisited", Int. J. of Hydrogen Energy, Vol. 25, Issue 12, December, (2000), pp. 1171-1183.
1. R. Mills, The Grand Unified Theory of Classical Quantum Mechanics, September 2001 Edition, BlackLight Power, Inc., Cranbury, New Jersey, Distributed by Amazon.com; January 2004 Edition posted at www.blacklightpower.com.

Section 104

Examiner Souw errs once again in arguing on pages 34-35 of this Appendix that:

(e) Applicant's reference to Ref.[80] for alleged "failures" of HUP is unpersuasive, since Ref [80] is written by Applicant himself, and has been deemed incredible for being full of mathematical flaws and incorrect interpretations of physics principles, as previously discussed. Applicant's misinterpretation of HUP is obviously also the source for his incorrect understanding of a number of references presented on pg.65 of his Response. Beyond his blind citation of the references, Applicant has failed to identify what he meant with "inconsistency" and "paradox".

This is NOT TRUE. As shown in Sections 66-67 above, other theoreticians such as those at Princeton University agree with Applicant's arguments given in ref. # 80. R. L. Mills, The Fallacy of Feynman's Argument on the Stability of the Hydrogen Atom According to Quantum Mechanics, Annales de la Fondation Louis de Broglie, submitted] that the Heisenberg Uncertainty Principle provides no atomic stability [E. H. Lieb, "The stability of matter", Reviews of Modern Physics, Vol. 48, No. 4, (1976), pp, 553-569.

Lieb [34] also addresses the fact that the Schrödinger equation has been accepted for over a half of a century without addressing the stability of matter. Lieb also shows that the Feynman argument is "false" due to an inappropriate application of the Heisenberg Uncertainty Principle and admonishes the misrepresentation in textbooks. By considering a wavefunction comprised of two components at two radii such that the electron can not have both sharply defined momentum and position in accordance with the Uncertainty Principle, Lieb shows that the radius can be arbitrarily small including zero such that the energy is negative infinity. This result is obviously not predictive of stability.

Furthermore, the approach by Feynman and Lieb are physically baseless. Attempts to prove that a system has a kinetic energy that exceeds some lower bound such that the total energy is not negative infinity is not based on physics since it ignores radiation-loss terms. More recently, Bugliaro at al. [35] have attempted to use QED to prove the stability of matter with N nonrelativistic electrons and K static nuclei of nuclear charge $\leq Ze$ that can interact with photons. Here, the problem is "rigged" since the radiation field is defined to be quantized, an ultraviolet cutoff is arbitrarily imposed, Maxwell's equations are not obeyed due to the defined properties of the polarizations, and creation and annihilation operators including the limitation of the couplings of

photons to electrons via Pauli operators only. Furthermore, the proof has nothing to do with the solutions of the actual atomic energy levels. Even then, stability is only found for a nuclear charge $Z \leq 6$. Thus, it is evident that neither the Schrödinger equation, variants thereof, or QED provide a general, self consistent, rigorous, and physical basis for the stability of matter.

34. E. H. Lieb, "The stability of matter", Reviews of Modern Physics, Vol. 48, No. 4, (1976), pp, 553-569.
35. L. Bugliaro, J. Fröhlich, G. M. Graf, "Stability of quantum electrodynamics with nonrelativistic matter", Physical Review Letters, Vol. 77, No. 17, (1996), pp. 3494-3497.

Furthermore, as demonstrated in Section 103 above, the implications of the HUP are not understood by the Examiner who creates a paradox between his insistence that physical laws and the HUP are both valid simultaneously.

Section 105

Examiner Souw further argues on Appendix page 35 that:

> "Inconsistency" or "paradox" exists in QM only in philosophical terms, depending on the philosophical standpoint of the individual author who made the statement, primarily with regard to what he/she defines as "reality" (cf. Laloë [5]). For example, the current Copenhagen interpretation of QM --more specifically regarding Schrödinger cat paradox, single particle interference, quantum entanglement, quantum teleportation etc.-- is neither a paradox nor inconsistency, when viewed from the philosophical standpoint of Logical Positivism [11-14] *(*= a modern version of Hume's classical positivism developed by the Vienna Circle --Bohr, Heisenberg, etc—, and is to date tacitly adopted by most physicists and scientists). Under this philosophical viewpoint, "reality" is defined solely as what is perceived by our five senses, as represented by experimental measurements (see, e.g., K. Nakhmanson, [11]).

In SQM, there is no reality in the absence of measurement, only math. Reality is only introduced by act of measurement, but then the measurement device is entangled with the object being measured. Then the meaning of reality is debated. Under CQM, mass, charge, electric and magnetic fields, energy, etc. are real and modeled by math. They are not math, nor do they obey math; rather they obey physics that is modeled by math. Thus, there is no need for philosophy and metaphysics.

Section 106

Examiner Souw's erroneous analysis is further exposed by his arguments on Appendix pages 35-36:

> Thus, it would be nonsense to talk about non-measurable parameters, such as suggested in the EPR paradox by some "hidden variables" and summarized in the well-known Bell's inequalities in consequence of the classical interpretation of "reality" as local realism. As of late, the Bell's theorem has been experimentally disproved in favor of the so-called Copenhagen interpretation of QM as a non-local theory [11, 15]. The Copenhagen interpretation of QM is also compatible with Pragmatism [16], which declares any knowledge on "reality", including scientific theories, as being "correct" only insofar as it is beneficial to human experience (i.e., not only capable of explaining, but also able to predict and control), the latter again referring to the five senses, or, in short, experimental measurements. The Copenhagen interpretation of QM is even compatible with Kant's metaphysics [15, 17] (foundation of modern philosophy, developed in the 18th century after Newton), which is heavily based on human reasoning (logic, mathematics) and proves that metaphysical "reality" beyond human five-sense perception is not accessible to human knowledge and/or intelligence, as described by his famous argument of "das Ding an sich", or the thing in itself.

The EPR paradox proposed by Einstein reveals that SQM is nonlocal and noncausal (predicts "spooky action" at a distance) in violation of special relativity. This is another contradiction to the Examiner's statement that he is applying physical laws, for which he has no response.

The Examiner's statement that "Bell's theorem has been experimentally disproved in favor of the so-called Copenhagen interpretation of QM as a non-local theory [11, 15]" is specifically noted. Using CQM, with conservation of the angular momentum of the excited-state calcium atom and the emitted photons, Applicant predicts exactly in closed-form equations the results of the Aspect experiment, thus restoring locality and causality and eliminating any need for the nonsensical philosophical, metaphysical flights of fantasy or other loosening of associations, delusions of grandeur, etc. associated with SQM. See Chp 37 of Mills GUT (Ref. #1).

Section 107

Examiner Souw continues with philosophical arguments, which are found on Appendix page 36:

> In contrast, Applicant's GUT is essentially incompatible with any of those major philosophical views, since the existence of hydrino is not based on experimental evidence (= five-sense perception), and furthermore, the hydrino can not be justified by reason, for obvious violation of logic/mathematics and known laws of nature. However, it is to be emphasized, philosophy is neither a subject matter of physics nor patent examination (non-statutory subject matter). The purpose of the above discussion is just to show that Applicant has misunderstood his own cited references regarding the alleged inconsistencies and paradoxes in QM given on pg.65.

Classical physical laws, however, require no philosophy. They are directly measurably and self evident. Applicant's GUT is predictive of 100's of experimental results. The prediction of hydrino is derived from the same physical laws. It has now been observed experimentally as predicted. It is another failure of SQM that it does not predict hydrino, but this result is expected since it is not predictive of a single experimental conjugate observable and over 80 years has degraded into a philosophical, metaphysical debate.

Section 108

Examiner Souw's philosophical struggle continues on page 36 of his Appendix, wherein he argues:

> It is to be emphasized, philosophy is totally irrelevant to science & technology, since it has no impact whatsoever on the "reality" itself. It does not matter whether Applicant considers single photon interference a paradox or not; a single photon that is split into different arms of an interferometer will still generate measurable interference effects. Similarly, an experiment designed to test the Bell theorem will invariably show the theorem is wrong (i.e., there is no hidden variable), no matter whether Applicant rejects a non-local QM theory as paradox, or accept QM as it is. This irrelevancy of philosophical interpretation is commonly shared by those skilled in the art, as also expressed, e.g., by Barth [18] on pg.2, col.2, lines 22-25.

Applicant has no response to the Examiner's conflict as to whether he should argue philosophy or not, or whether he thinks it is irrelevant or not. Once the Examiner takes a position, Applicant can respond.

Regardless, the results of the double-slit experiment, they are derived in closed-form equations from physical laws and appear in Chp. 8 Mills GUT. The double-slit experiment for the electron is also solved classically in Chp. 8, and the computer animation is available at:
http://www.blacklightpower.com/theory/theory.shtml

Section 109

Examiner Souw further states on Appendix page 37:

> For all the reasons stated above, Applicant's contention that the conventional QM is in "serious trouble" because it allegedly entails unsolvable paradoxes and inconsistencies, hence, needs to be rejected and/or drastically revised, is totally unpersuasive.

The Examiner provides no remedy to the paradoxes of SQM which even he exposes. Rather than address them, he chooses to ignore them in a smoke screen of fluid, contradictory philosophical and metaphysical views. Why is not the existence of paradoxes grounds to even question the validity of SQM? Why is a PTO Examiner even mired in such issues? Why is he wasting Applicant's time with such existential issues? Is this practice widespread or limited to the present Applicant? Is it because Applicant used physics to solve the atom exactly and this is embarrassing to SQM practitioners who espouse virtual particles, "spooky actions", infinities, compactified dimensions and other such fantasies? Is the Examiner trying to coerce inventors to adhere to his philosophies/religion?

With CQM, philosophical issues do not exist. It is predictive. So, why is Applicant's invention not being reviewed based on the merits and real-world data? Why the obfuscation based on the presumption that SQM is the correct theory of nature when quantum aficionados including the Examiner are incapable of characterizing reality according SQM?

The Examiner has failed to answer any of these questions.

Section 110

Examiner Souw's arguments on page 37 of his Appendix regarding spin are also without merit:

> 8. **Applicant's confusion regarding electron spin**
>
> Applicant has failed to address the Examiner's refutation in the previous Appendix. Applicant's spin wave function as postulated (but not derived) in GUT and repeated on pg.65-69 is mathematically flawed, since it contains mathematical inconsistencies and self-contradictions, as discussed in the previous Appendix (sect.6/pg.5-7), and more specifically in section 6 above. The Stern-Gerlach experiment has been adequately explained by Goudsmit and Uhlenbeck based on electron spin, which theoretically also agrees with the Pauli theory that represents the wavefunctions of a particle with spin 1/2 as 2-dimensional column-vector functions, $ø^+$ and $ø^-$, known in the art as Pauli wave functions [3,7]. These Pauli functions have been previously shown to be in perfect agreement with the spin functions **á** and **â** defined by Applicant's own cited reference [1]. These, however, turned out to disagree with Applicant's statement and formulations, as described above in section 6.

Not only has Applicant derived the spin function in Chp 1 and Appendix III of Mills GUT, he as also produced computer simulations that can assist the Examiner in unequivocally understanding Applicant's solution:
http://www.blacklightpower.com/theory/theory.shtml (under "Computation Files")

The results of the closed-form equations that contain fundamental constants only can not be matched by SQM. The spin function of SQM is postulated and is not predictive. It is not correct. It is nonphysical since current can not exist in zero dimensions. It posses infinite magnetic-field energy, and it misses the g factor example. Whereas, Applicant's CQM calculation matches observations to 11 figure accuracy (see Sections 88 and 92 above), the maximum limit possible based on the experimental error in the fine structure constant (the only parameter).

Section 111

Examiner Souw repeats previous errors in his arguments appearing on Appendix pages 37-38:

> Therefore, the Stern-Gerlach experiment does not need Applicant's explanation; not only because the underlying theory is incredible, but also

because the explanation and prediction provided by the conventional QM is far more superior, far more quantitative and accurate, and --without falling into self-contradiction-- far more comprehensive than what Applicant has to offer. In this regard, Applicant's attempt to defend his derivation of spin-orbital wave function by combining the spin and orbital functions in one single function of (r,t) has been proven to be based on a misunderstanding over his own reference McQuarrie [1], specifically with regard to Pauli eigenfunctions, as described above and in section 6. A correct interpretation of this Pauli eigenfunctions has been demonstrated by the Examiner by successful application of the conventional QM, as evidenced by elaborate mathematical calculations of intricate line splitting and intensities that have been experimentally verified to be extremely accurate to better than 10^{-5} nm [3]. This accuracy is far more superior to the 0.1 nm accuracy of Applicant's measurements. Accordingly, Applicant's argument regarding this subject matter is totally unpersuasive.

These arguments are redundant of those found in other sections in this Response.

The current (SQM) explanation of the Stern-Gerlach experiment is postulated and physically impossible (current in zero dimensions), and it is not predictive as discussed above. CQM is in a league of its own in that is gives an exact current distribution that reproduces all of the observations related to spin with extreme accuracy.

Section 112

Examiner Souw further argues on Appendix page 38 that:

9. Regarding "Applicant's hydrogen wave function is seriously flawed"

Similar to most of his other remarks, here Applicant does not even try to refute the Examiner's arguments as presented in the previous Appendix, but merely re-iterate his position as already presented in his evidently flawed GUT. The incredibly-large amount of mathematical flaws and incorrect understanding of physical principles ultimately disqualifies the GUT as a scientific theory. Every argument based on GUT is therefore unpersuasive.

That the Examiner admits that Applicant has a GUT concedes a triumph over SQM which is incompatible with General Relativity and has dismaly failed in unifying physics for over 80 years. The failure to find the predicted Higgs bosom to account for

the masses of fundamental particles and the disproof of the HUP by the Hubble images are just the latest in the string of failures of SQM with decades of wasted manpower and billions of wasted taxpayer dollars. While it may be difficult, the Examienr must face this fact.

In contrast, in addition to precisely predicting atomic observables in closed-form exact equations with fundamental constants only—a feat never achieved by SQM for a single example—CQM unifies the physical laws as discussed in Mills GUT (Ref. #1):

QUANTUM THEORY PAST AND FUTURE

The Schrödinger equation was originally postulated in 1926 as having a solution of the one-electron atom. It gives the principal energy levels of the hydrogen atom as eigenvalues of eigenfunction solutions of the Laguerre differential equation. But, as the principal quantum number n>>1, the eigenfunctions become nonsensical. Despite its wide acceptance, on deeper inspection, the Schrodinger solution is plagued with many failings as well as difficulties in terms of physical interpretations that have caused it to remain controversial since its inception. Only the one-electron atom may be solved without approximations, but it fails to predict electron spin, leads to models with nonsensical consequences such as negative energy states of the vacuum, infinities, and negative kinetic energy, and it fails to predict the stability of the atomic hydrogen $n = 1$ state except for an arbitrary definition[28] [5, 17, 53, 58, 80, 94, 102, 106, 107]. In addition to many predictions which simply do not agree with observations even regarding the one-electron atom [5, 17, 53, 58, 80, 94, 102, 106, 107], the Schrödinger equation predicts noncausality, nonlocality, spooky actions at a distance or quantum telepathy, perpetual motion, and many internal inconsistencies where contradicting statements have to be taken true simultaneously. Recently, the behavior of free electrons in superfluid helium has again forced the issue of the meaning of the wavefunction. Electrons form bubbles in superfluid helium which reveal that the electron is real and that a physical interpretation of the wavefunction is necessary. Furthermore, when irradiated with light of energy of about a 0.5 to several eV [111], the electrons carry current at different rates as if they exist with different sizes. It has been proposed that the behavior of free electrons in superfluid helium can be explained in terms of the electron breaking into pieces at superfluid helium temperatures [111]. Yet, the electron has proven to be indivisible even under particle accelerator collisions at 90 GeV (LEPII). The nature of the wavefunction must now be addressed. It is time for the physical rather than the mathematical nature of the wavefunction to be determined.

A classical quantum mechanics (CQM) theory is herein derived from first principles that successfully applies physical laws on all scales. CQM gives closed form physical solutions for the electron in atoms, the free electron, and the free electron in superfluid helium. The prediction of fractional principal quantum energy states of the

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[28] The Schrodinger equation can only yield integer eigenvalue solutions by selection or definition from an infinite number of possibilities since the solution is over all space with no boundary (i.e. 0 to ∞). In contrast, wave equation solutions with integers are common for boundary constrained systems such as waveguides and resonators.

electron in liquid helium match the photoconductivity and mobility observations without requiring that the electron is divisible [17, 53].

In CQM, the classical wave equation is solved with the constraint that a bound electron cannot radiate energy. The mathematical formulation for zero radiation based on Maxwell's equations follows from a derivation by Haus [108]. The function that describes the motion of the electron must not possess spacetime Fourier components that are synchronous with waves traveling at the speed of light. CQM gives closed form solutions for the atom including the stability of the $n=1$ state and the instability of the excited states, relativistic invariance of the wave equation, the equations of the photon and electron in excited states, and the equations of the free electron and photon which also predict the wave-particle duality behavior of particles and light. The current and charge-density functions of the electron may be directly physically interpreted. For example, spin angular momentum results from the motion of negatively charged mass moving systematically, and the equation for angular momentum, $\mathbf{r} \times \mathbf{p} = \hbar$, can be applied directly to the wave function (a current-density function) that describes the electron. A partial listing of well-known and documented phenomena which are derivable in closed form from CQM based on Maxwell's equations are given in Table 1. The calculations agree with experimental observations.

Table 1. Partial List of Physical Phenomena Solved by CQM.

• Stability of the atom to radiation	• Compton effect
• Magnetic moment of a Bohr magneton and relativistic invariance of each of $\frac{e}{m_e}$ of the electron, the electron angular momentum of $\hbar$, and the electron magnetic moment of μ_B from the spin angular momentum	• Wave-particle duality
• Stern Gerlach experiment	• Double-slit experiment for photons and electrons
• Electron and muon g factors	• Davisson Germer experiment
• Rotational energies and momenta	• Elastic electron scattering from helium atoms
• Reduced electron mass	• Ionization energies of multielectron atoms
• Ionization energies of one-electron atoms	• Hydride ion binding energy and absolute NMR shift
• Special relativistic effects	• Excited states of the helium atom
• Excited states	• Proton scattering from atomic hydrogen
• Resonant line width and shape	• Nature of the chemical bond
• Selection rules	• Bond energies, vibrational energies, rotational energies, and bond distances of hydrogen-type molecules and molecular ions, absolute NMR shift of H_2
• Correspondence principle	• Superconductivity and Josephson junction experiments
• Orbital and spin splitting	• Integral and fractional quantum Hall effects
• Stark effect	• Aharonov-Bohm effect
• Lamb Shift	• Aspect experiment
• Knight shift	• Durr experiment on the Heisenberg Uncertainty Principle
• Spin-orbital coupling (fine structure)	• Penning trap experiments on single ions
• Spin-nuclear coupling (hyperfine structure)	• Hyperfine structure interval of positronium
• Hyperfine structure interval of muonium	• Magnetic moments of the nucleons
• Nature of the free electron	• Beta decay energy of the neutron
• Nature of the photon	• Binding energy of deuterium
• Photoelectric effect	• Alpha decay

For any kind of wave advancing with limiting velocity and capable of transmitting signals, the equation of front propagation is the same as the equation for the front of a light wave. By applying this condition to electromagnetic and gravitational fields at particle production, the Schwarzschild metric (SM) is derived from the classical wave equation which modifies general relativity to include conservation of spacetime in addition to momentum and mass-energy. The result gives a natural relationship

between Maxwell's equations, special relativity, and general relativity. It gives gravitation from the atom to the cosmos. The universe is time harmonically oscillatory in matter, energy, and spacetime expansion and contraction with a minimum radius that is the gravitational radius. A partial listing of the particle and cosmological phenomena derivable from CQM in closed form equations with fundamental constants only is given in Table 2.

Table 2. Partial List of Particle and Cosmological Phenomena Solved by CQM.

• Deflection of light by stars	• Power spectrum of the universe
• Precession of the perihelion of Mercury	• Microwave background temperature
• Lepton masses	• Uniformity of the microwave background radiation
• Quark masses	• Microkelvin spatial variation of the microwave background radiation measured by DASI
• Hubble constant	• Polarization of DASI data
• Age of the universe	• Observed violation of the GZK cutoff
• Observed acceleration of the expansion	• Mass density of the universe
• Power of the universe	• Large scale structure of the universe

CQM further gives the identity of dark matter which matches the criteria for the structure of galaxies and spectral lines from interstellar medium and the Sun which have been observed in the laboratory [28, 33-36, 50, 63, 67, 71, 73, 75-76, 78, 86-87, 90]. In a special case wherein the gravitational potential energy density of a blackhole equals that of the Planck mass, matter converts to energy and spacetime expands with the release of a gamma ray burst. The singularity in the SM is eliminated.

After decades of futility, QM and the Heisenberg Uncertainty Principle have not yielded a unified theory, are still purely mathematical, and have yet to be shown to be based in reality[29] [5, 17, 53, 58, 80, 94, 102, 106, 107]. Both are based on circular

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[29] From the time of its inception, quantum mechanic (QM) has been controversial because its foundations are in conflict with physical laws and are internally inconsistent. Interpretations of quantum mechanics such as hidden variables, multiple worlds, consistency rules, and spontaneous collapse have been put forward in an attempt to base the theory in reality. Unfortunately many theoreticians ignore the requirement that the wave function must be real and physical in order for it to be considered a valid description of reality. For example, regarding this issue Fuchs and Peres believe [112] "Contrary to those desires, quantum theory does *not* describe physical reality. What it does is provide an algorithm for computing *probabilities* for macroscopic events ("detector ticks") that are the consequences of our experimental interventions. This strict definition of the scope of quantum theory is the only interpretation ever needed, whether by experimenters or theorists."

With Penning traps, it is possible to measure transitions including those with hyperfine levels of electrons of single ions. This case can be experimentally distinguished from statistics over equivalent transitions in many ions. Whether many or one, the transition energies are always identical within the resonant line width. So, *probabilities* have no place in describing atomic energy levels. Moreover, quantum theory is incompatible with probability theory as discussed previously [17, 107].

The Copenhagen interpretation provides another meaning of quantum mechanics. It asserts that what we observe is all we can know; any speculation about what an electron, photon, atom, or other atomic-sized entity is really or what it is doing when we are not looking is just that—speculation. The postulate of quantum measurement asserts that the process of

measuring an observable forces it into a state of reality. In other words, reality is irrelevant until a measurement is made. In the case of electrons in helium, the fallacy with this position is that the "ticks" (migration times of electron bubbles) reveal that the electron is real before a measurement is made [17, 107]. Furthermore, experiments on Ba^+ in a Penning trap discussed in the Inconsistencies of Quantum Mechanics section demonstrate that the postulate of quantum measurement of quantum mechanics is experimentally disproved. These issues and other such flawed philosophies and interpretations of experiments that arise from quantum mechanics are discussed in the Retrospect section and Ref. [17, 80, 107].

QM gives correlations with experimental data. It does not explain the mechanism for the observed data. But, it should not be surprising that it gives good correlations given that the constraints of internal consistency and conformance to physical laws are removed for a wave equation with an infinite number of solutions wherein the solutions may be formulated as an infinite series of eigenfunctions with variable parameters. There are no physical constraints on the parameters. They may even correspond to unobservables or "flights of fantasy" such as probability waves, virtual particles, negative energy of the vacuum, polarization of the vacuum by virtual particles, infinities, renormalization, effective nuclear charge, ionic terms in the perturbation series, fermion propagators, virtual photon annihilation, virtual photon emission and reabsorption, virtual electron positron annihilation, photon propagators, plethora of postulated super-symmetry virtual particles which make contributions such as smuon-neutralino and sneutrino-chargino loops, neutrino oscillation, worm holes, parallel universes, hyperdimensions, parallel mind universes, quantum telepathy, entanglement, spooky actions at a distance, faster than light travel, dark energy, exotic particles comprising dark matter, the universe from nothing, big bang-inflation-deceleration-reacceleration of the universe, and so on and so on. With mathematics, it is possible to represent an infinite number of models with limitless fantasy. If you invoke the constraints of internal consistency and conformance to physical laws, quantum mechanics has never successfully solved a physical problem.

Throughout the history of quantum theory, wherever there was an advance to a new application, it was necessary to repeat a trial and error experimentation to find which method of calculation gave the right answers. Often the textbooks present only the successful procedure as if it followed from first principles; and do not mention the actual method by which it was found. In electromagnetic theory based on Maxwell's equations, one deduces the computational algorithm from the general principles. In quantum theory, the logic is just the opposite. One chooses the principle to fit the empirically successful algorithm. For example, we know that it required a great deal of art and tact over decades of effort to get correct predictions out of Quantum Electrodynamics (QED). For the right experimental numbers to emerge, one must do the calculation (i.e. subtract off the infinities) in one particular way and not in some other way that appears in principle equally valid. There is a corollary, noted by Kallen: from an inconsistent theory, any result may be derived.

Reanalysis of old experiments and many new experiments including electrons in superfluid helium challenge the Schr\O(o,¨)dinger equation predictions. Many noted physicists rejected quantum mechanics. Feynman also attempted to use first principles including Maxwell's Equations to discover new physics to replace quantum mechanics [113]. Other great physicists of the 20th century searched. "Einstein [...] insisted [...] that a more detailed, wholly deterministic theory must underlie the vagaries of quantum mechanics" [114]. He felt that scientists were misinterpreting the data. Examples of quantum mechanical misinterpretations of experiments are:

1.) The rise in current of free electrons in superfluid helium when irradiated with low-energy light and the formation of an unexpected plethora of exotic negative charge carriers in superfluid helium with mobilities greater than that of the normal electron are due to the electron breaking into fractional pieces.

2.) Virtual particles surround the electron, and as the electron's center is approached, they shield the electron's charge less effectively.

3.) Spooky actions at a distance are predicted.

4.) The purely postulated Hund's Rule and the Pauli Exclusion Principle of the assignment of unique quantum numbers to all electrons are "weird spooky action" phenomena unique to quantum mechanics that require all electrons in the universe to have instantaneous communication and coordination with no basis in physical laws such as Maxwell's equations.

5.) Since fundamental particles are probability waves and their position and energy are uncertain according to the Uncertainty Principle, they can "magically" appear on the other side of a supposedly insurmountable energy barrier based on their energy on the initial side of the barrier. Thus, they defy physical laws and tunnel through the barrier.

6.) A ${}^{9}Be^{+}$ ion may be in two separate locations at once.

7.) Supercurrent may go in both directions at once.

8.) Perpetual motion is predicted.

9.) A weak force is observed between the two precision machined plates with minuscule separation because the plates serve to limit the number of virtual particle modes between the plates as opposed to those outside the plates and the resulting imbalance in pressure between two infinite quantities gives rise to the feeble force known as the Casimir effect.

10.) The *postulated* Quantum Electrodynamics (QED) theory of $\frac{g}{2}$ is based on the determination of the terms of a *postulated* power series in α / π where each *postulated* virtual particle is a source of *postulated* vacuum polarization that gives rise to a *postulated* term. The algorithm involves scores of *postulated* Feynman diagrams corresponding to thousands of matrices with thousands of integrations per matrix requiring decades to reach a consensus on the "appropriate" *postulated* algorithm to remove the intrinsic infinities.

11.) The muon g factor g_μ is required to be different from the electron g factor in the standard model due to the mass dependent interaction of each lepton with vacuum polarizations due to virtual particles. The BNL Muon (g-2) Collaboration used a "magic" $\gamma = 29.3$ which satisfied the BMT equation identically for the theoretical value of $\frac{g_\mu}{2}$ with assumption that $\frac{g_\mu}{2} \neq \frac{g_e}{2}$ and obtained a measured result that was internally consistent.

12.) The expansion of the universe is accelerating due to the presence of "dark energy" throughput all space.

13.) According to Nesvizhevsky et al. [115], a step in the transmission of falling neutrons through a variable-height channel comprising a mirror on the bottom and an absorber at the top occurred at a height of $13\ \mu m$ because neutrons fell in quantized jumps.

14.) The lowest energy vibrational state of any molecule is not zero rather, in violation of the second law of thermodynamics and experimental observation such as the formation of a Bose-Einstein condensate of molecules, it is the zero order vibration of $\frac{1}{2} h\nu = \frac{1}{2}\sqrt{\frac{k}{\mu}}$ that is equivalent to zero point energy.

15.) Since flux is linked by a superconducting loop with a weak link in quantized units of the magnetic flux quantum, $\Phi_0 = \frac{h}{2e}$, the basis of superconductivity is interpreted as arising from the formation of electron pairs corresponding to the $2e$ term in the denominator; the so-called Cooper pairs form even though electrons repel each other, the electron repulsion should increase the resistance to electron flow, and such pairs can not form at the critical temperature of high T_c superconductors.

***THEN THERE IS REALITY*:**

1.) Fractional principal quantum energy states of the electron in liquid helium match the photoconductivity and mobility observations without requiring that the electron is divisible.

2.) The electron is an extended particle rather than a point, and the charge-density is greatest in the center.

3.) Photon momentum is conserved on a photon by photon basis rather than statistically as predicted by quantum mechanics which predicts photon coincidence counts at separated detectors (Aspect experiment).

4.) The observations that all electrons have unique quantum numbers and that the electron configuration of atoms follows a pattern based on solutions of Laplace's equation are phenomenological consequences of physical laws such as Maxwell's equations.

5.) Fundamental particles such as an electron are real, extended particles, each of size equal to its de Broglie wavelength rather than a point-particle-probability-wave. Potential energy is gained as the particle traverses the barrier which is cleared; even though, its initial kinetic energy was less than the barrier height. Energy conservation is obeyed at all

times. Tunneling arises from physical laws.

6.) The fluorescence emission spectrum of a Penning trapped $^{9}Be^{+}$ ion shows interference peaks due to coupling between oscillator modes and a Stern Gerlach transition.

7.) The energy difference of a superconducting loop observed by Friedman et al. matches the energy corresponding to the flux linkage of the magnetic flux quantum by the ensemble of superconducting electrons in their entirety with a reversal of the corresponding macroscopic current.

8.) Perpetual motion is not permitted or observed.

9.) The Casimir effect is predicted by Maxwell's equations wherein the attractive force is due only to the interactions of the material bodies themselves. Charge and current fluctuations in a material body with a general susceptibility serve as source terms for Maxwell's equations, i.e. classical fields, subject to the boundary conditions presented by the body surfaces. In the limiting case of rarefied media, the van der Waal force of interaction between individual atoms is obtained.

10.) The remarkable agreement between Eqs. (1.204) and (1.205) of the Electron g Factor section demonstrates that $\frac{g}{2}$ may be derived in closed form from Maxwell's equations in a simple straight forward manner that yields a result with eleven figure agreement with experiment—the limit of the experimental capability of the measurement of the fundamental constants that determine α.

11.) Rather than indicating an expanded plethora of postulated super-symmetry virtual particles which make contributions such as smuon-neutralino and sneutrino-chargino loops, the muon, like the electron, is a lepton with $\hbar$ of angular momentum, and the muon and electron g factors are predicted by CQM to be identical. Using the experimental "magic" $\gamma = 29.3$ and $\frac{g_\mu}{2} = \frac{g_e}{2}$ in the BMT equation, the predicted measurement exactly matched $\frac{g_\mu}{2}$ measured by the BNL Muon (g-2) Collaboration proving that their assumption that the $\gamma = 29.3$ condition eliminated the effect of the electrostatic field on ω_a was flawed and showed the equivalence of the muon and electron g factors.

12.) The constant maximum speed, c, for the propagation of light and gravity results in the conservation relationship of mass-energy, $E = mc^2$ and spacetime, $\frac{c^3}{4\pi G} = 3.22\ X\,10^{34}\ \frac{kg}{\text{sec}}$. Spacetime expands as mass is converted to energy, and the predictions match the observed Hubble constant and the acceleration of the expansion.

13.) The de Broglie wavelength in the vertical direction corresponding to the scattering of a falling neutron from the mirror to the absorber was given by $\lambda = z_1 = \frac{1}{2}\left(\frac{h}{m_n}\right)^{2/3}(g)^{-1/3} = 12.6\ \mu m$ where h is Planck's constant, m_n is the mass of the neutron, and g is the acceleration due to gravity. For absorber heights greater than $13\ \mu m$, the height was greater than the de Broglie wavelength; thus, a step in the transmission of failing neutrons occurred at $13\ \mu m$. The observed transmission matched identically that predicted by Newton's Law of Gravitation; no quantum gravity effect was observed.

14.) The lowest energy vibrational state of any molecule is zero as its lowest vibrational and rotational energies, and the molecules can be solved using first principles in closed form equations in agreement with experimental observations including the difference in bond energies and vibrational energies with isotopes substitution.

15.) To conserve the electron's invariant angular momentum of $\hbar$, flux is linked by each electron in quantized units of the magnetic flux quantum, $\Phi_0 = \frac{h}{2e}$, and the basis of superconductivity is a correlated flow of an ensemble of individual electrons such that no energy is dissipated (i.e. superconductivity arises when the lattice is a band-pass for the magnetic field of an array of magnetic dipoles; so, no energy is dissipated with current flow).

CQM explains the data based on reality versus fantastical interpretations of probability wave equation solutions.

arguments that the electron is a probability wave requiring that the electron have multiple positions and energies including negative and infinite energies simultaneously. Both are postulated, cannot be proven experimentally, and predict consequences such as violation of conservation of energy and momentum and an essentially infinite cosmological constant [17, 80, 102, 106, 107] and Ref. [116]. These predictions are not in agreement with experimentation. Furthermore, it was recently proven experimentally that the Heisenberg Uncertainty principle has nothing to do with wave-particle duality as shown in Refs. [17, 80, 107], the Wave-Particle Duality is Not Due to the Uncertainty Principle section, and Ref. [117]; whereas, the opposite is largely touted as one of its triumphs.

In contrast, the predictions of CQM are unprecedented in that agreement with observations is achieved over 85 orders of magnitude from the scale of fundamental particles to that of the cosmos. Observable features of atomic particles such as the electron g factor may be calculated in closed form from Maxwell's equations with 11 figure accuracy without invoking the vagaries and inconsistencies inherent with QM and the Heisenberg Uncertainty Principle.

OUTLINE OF THE RESULTS OF THE UNIFIED THEORY DERIVED FROM FIRST PRINCIPLES

To overcome the limitations of quantum mechanics, physical laws which are exact on all scales are sought. Rather than engendering the electron with a wave nature as suggested by the Davisson-Germer experiment and fabricating a set of associated postulates and mathematical rules for wave operators, a new theory is derived from first principles.

Foundations:

- Physical laws apply on all scales (especially Maxwell's)
- Absolute internal consistency even between widely different phenomena,
- Conservation of linear and angular momentum,
- Charge conservation,
- First and second law of thermodynamics,
- Constant maximum of the speed of light in a vacuum,
- Special relativity with Newton's laws in the low speed limit,

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These examples are given in Appendix II: Quantum Electrodynamics is Purely Mathematical and Has No Basis in Reality, Appendix IV: Muon g Factor, the Retrospect section, the Gravity section, and Refs. [5, 17, 53, 58, 80, 94, 102, 106, 107]. Tunneling phenomena are derived in the Alpha Decay section and the Schrödinger Fat Cats—Another Flawed Interpretation section.

- Conservation of matter/energy,

- General relativity derived from Maxwell's equations using the constant maximum propagation of any signal including the gravitational field which gives the Schwarzschild metric and conservation of spacetime as well as matter/energy with no cosmological constant; Newtonian gravitation in the weak field limit which forbids a cosmological constant,

- A vacuum is a vacuum,

- 4 dimensional spacetime, and

- The only allowed parameters are the measured fundamental constants.

The novel theory of Classical Quantum Mechanics (CQM) unifies Maxwell's Equations, Newton's Laws, and General and Special Relativity. The closed form calculations of a broad spectrum of fundamental phenomena containing fundamental constants only are given in subsequent sections. CQM gives closed form solutions for the atom which give four quantum numbers, the Rydberg constant, the stability of the $n = 1$ state and the instability of the excited states, relativistic invariance of the wave equation, the equations of the photon and electron in excited states, the equations of the free electron, and photon which predict the wave particle duality behavior of particles and light. The current and charge-density functions of the electron may be directly physically interpreted. For example, spin angular momentum results from the motion of negatively charged mass moving systematically, and the equation for angular momentum, $\mathbf{r} \times \mathbf{p} = \hbar$, can be applied directly to the wave function (a current-density function) that describes the electron. The magnetic moment of a Bohr magneton, Stern Gerlach experiment, electron and muon g factors, fine structure splitting, Lamb shift, hyperfine structure, muonium hyperfine structure interval, resonant line width and shape, selection rules, correspondence principle, wave particle duality, excited states, reduced mass, rotational energies and momenta, spin-orbital coupling, Knight shift and spin-nuclear coupling, closed form solutions for one, two, and three electron atoms, excited states of the helium atom, elastic electron scattering from helium atoms, proton scattering from atomic hydrogen, the nature of the chemical bond, bond energies, vibrational energies, rotational energies, and bond distances of hydrogen-type molecules and molecular ions, Davisson Germer experiment, Aspect experiment, Durr experiment on the Heisenberg Uncertainty Principle, Penning trap experiments on single ions, hyperfine structure interval of positronium, magnetic moments of the nucleons, beta decay energy of the neutron, the binding energy of deuterium, and alpha decay are derived in closed form equations based on Maxwell's equations. The theory of collective phenomena including statistical mechanics, superconductivity and Josephson junction experiments, integral and fractional quantum Hall effects, and the Aharonov-Bohm effect is given. The calculations agree with experimental observations.

From the closed form solution of the helium atom, the predicted electron scattering intensity is derived. The closed form scattering equation matches the

experimental data; whereas, calculations based on the Born model of the atom utterly fail at small scattering angles. The implications for the invalidity of the Schrödinger and Born models of the atom and the dependent Heisenberg Uncertainty Principle are discussed.

For any kind of wave advancing with limiting velocity and capable of transmitting signals, the equation of front propagation is the same as the equation for the front of a light wave. By applying this condition to electromagnetic and gravitational fields at particle production, the Schwarzschild metric (SM) is derived from the classical wave equation which modifies general relativity to include conservation of spacetime in addition to momentum and matter/energy. The result gives a natural relationship between Maxwell's equations, special relativity, and general relativity. It gives gravitation from the atom to the cosmos. The gravitational equations with the equivalence of the particle production energies permit the equivalence of mass-energy and the spacetime wherein a *"clock" is defined that measures "clicks" on an observable in one aspect, and in another, it is the ruler of spacetime of the universe with the implicit dependence of spacetime on matter-energy conversion.* The masses of the leptons, the quarks, and nucleons are derived from this metric of spacetime. The universe is time harmonically oscillatory in matter, energy, and spacetime expansion and contraction with a minimum radius that is the gravitational radius. In closed form equations with fundamental constants only, CQM gives the basis of the atomic, thermodynamic, and cosmological arrows of time, the deflection of light by stars, the precession of the perihelion of Mercury, the Hubble constant, the age of the universe, the observed acceleration of the expansion, the power of the universe, the power spectrum of the universe, the microwave background temperature, the primary uniformity of the microwave background radiation, the polarization and microkelvin temperature spatial variation of the microwave background radiation measured by DASI, the observed violation of the GZK cutoff, the mass density of the universe, the large scale structure of the universe, and the identity of dark matter which matches the criteria for the structure of galaxies and spectral lines from interstellar medium and the Sun which have been observed in the laboratory [25-26]. In a special case wherein the gravitational potential energy density of a blackhole equals that of the Planck mass, matter converts to energy and spacetime expands with the release of a gamma ray burst. The singularity in the SM is eliminated.

Section 113

Examiner Souw repeats the following previously flawed arguments on pages 38-39 of his Appendix:

10. Regarding Applicant's incorrect application of Einstein's Special Relativity

Applicant's repeat of his GUT derivation is unpersuasive, since it does not address the Examiner's point of refutation as brought up the previous Appendix. The Examiner's refutation was/is, that Applicant's application of Einstein's Relativity Theory to an orbiting electron is

fundamentally wrong, since such a system is not an inertial system, and hence, the Lorentz contraction is not applicable. There appears to be a lack of appreciation by the applicant of the crucial difference between inertial systems and non-inertial systems, which is most fundamental to Einstein's Relativity Theory. Therefore, Applicant's entire argument is unpersuasive.

These arguments are redundant of those rebutted in previous Sections of this Response (see, e.g., Sections 55 and 81 above).

Section 114

Examiner Souw asserts on page 39 of his Appendix that:

11. Applicant's failure to respond to specific refutations in the original Souw Appendix

Besides Applicant's failure to persuasively argue against the Examiner's refutation of GUT as raised in the original Appendix, Applicant has left these points un-responded:

(a) Applicant's misinterpretation of the radial function in QM that allegedly goes straight through the nucleus, which is raised by the Examiner in sect. 9 of the original Appendix.

According to SQM textbooks, the electron is in the nucleus. A theory of the hydrogen atom can not be correct if it requires that the electron is in the nucleus. Thus, SQM is fatally flawed as discussed in Ref. # 17 and 80. A valid theory can not permit the electron to "spiral into the nucleus". However, an inescapable fact of SQM is that the wave function solution of the SE requires that **the electron is in the nucleus** [17, 80]. In fact, the electron must exist in the nucleus since the wave function is a maximum there. This is clearly claimed in the literature as discussed by Karplus to explain the spin-nuclear coupling called Fermi contact interaction for example [M. Karplus and R. N. Porter, *Atoms and Molecules an Introduction for Students of Physical Chemistry*, The Benjamin/Cummings Publishing Company, Menlo Park, California, (1970), p. 567]. In fact, the probability density function Ψ^2 has a maximum at the nucleus for the n=1 state, and the nucleus has a finite volume. Griffiths gives the time average that the electron is in the nucleus [D. J. Griffiths, *Introduction to Quantum Mechanics*, Prentice-Hall, (1995), Prob. 4.14]. This situation corresponds to infinite

energy using Feynman's correct assertion [80] that the Coulomb potential must apply to the interaction of the electron and the nucleus.

Section 115

Examiner Souw further repeats previously rebutted arguments on Appendix page 39:

> (b) The Examiner's invitation for Applicant to use his GUT to calculate line intensities that are verifiable by experimental measurement, as done by the examiner in his two cited own works [3, 4] remains un-responded.

These arguments are redundant having already been disposed of in Section 59 above.

Section 116

Examiner Souw concludes his error-plagued Appendix with additional erroneous statements on pages 39-40:

> **Conclusion:**
>
> Applicant's response has failed to remove the Examiner's points of refutation as brought in the original Souw Appendix, some of which having been improperly addressed, or even left-out un-addressed. Consequently, all points of the Examiner's refutation remain in force, and are re-instated herein by incorporation, in addition to the above new proofs of Applicant's errors and misunderstanding brought up in his response(s). The Examiner does not evaluate GUT from an exclusive viewpoint of QM, as alleged by Applicant, but takes account of the fact that GUT is trying to disagree with QM, i.e., by fully considering every point of Applicant's arguments. Thus, the Examiner has evaluated the GUT on its own merit based on its scientific credibility, i.e., its validity with regard to mathematical basis and experimental evidence. It was found, none of the criteria required by the conventional standard for scientific theory and/or patentable invention has been fulfilled.

As indicated by the independent reviews listed above in Section 54 and some of the stunning results of closed-form equations presented above in Sections 54-55 and the attached tables:

Tables summarizing the results of the calculated and experimental parameters of H_2, D_2, H_2^+ and D_2^+, one, two, three, four, five, six, seven, eight, nine, ten, eleven, twelve, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, and twenty-electron atoms, the excited states of helium, the electron g factor, and relations between fundamental particles. The closed-form derivations from Maxwell's equations given in

The Grand Unified Theory of Classical Quantum Mechanics posted at http://www.blacklightpower.com/bookdownload.shtml

contain fundamental constants only. The nature of the chemical bond is given in Chp. 12. The atoms are solved exactly in Chps. 1, 7, and 10. The excited states of helium are solved exactly in Chp. 9. The electron g factor and relations between fundamental particles are given in Chp. 1 and Chps. 27 and 30, respectively.

These results can not be replicated by SQM, nor can CQM's extraordinary predictiveness. The successes over 85 orders of magnitude of scale demonstrate that CQM is the correct physics of nature from the scale of the quarks to the cosmos. It successfully predicted the mass of the top quark, the acceleration of the expansion of the universe, and the characteristics of hydrino that have been verified in over 112 journal articles and 51 independent reports and journal articles.

The Examiner is blinded by his biases that he can not even appreciate. His argument that he is applying physical laws while defending the validity of the HUP is contradictory and indicative of his bias or incapacity to understand the conflict. Even more troubling is the Examiner's degradation to philosophical and metaphysical debates. This is inappropriate for a PTO official and has unfairly delayed allowance of this case.

Section 117

Examiner Souw further errouneously argues on Appendix page 4 that:

> On pages 105-106 of applicant's 188 page response filed on 10/22/2004, applicant asserts that there is an enormous body of additional theoretical support that applicant has submitted for the new states of hydrogen and that the applicant has provided an enormous body of experiment evidence that lower-energy hydrogen states are produced by the disclosed catalytic reaction. However, this assertion is unrelated to the Examiner's argument that there is no theoretical or experimental support for new forms of one electron atoms having an atomic mass of at least four and having an increased binding energy greater than the binding energy of the corresponding ordinary one electron atom because these new forms of one electron atoms having an atomic mass of at least four are not hydrino atoms. Nevertheless, since applicant uses the same mathematically and scientifically flawed theory of the hydrino atom as theoretical support for one-electron atoms having an atomic mass of at least four and having an increased binding energy greater than the binding energy of the corresponding ordinary one electron atom, the Examiner remains unpersuaded that these novel forms of one electron atoms are theoretically supported or actually exist for the same reasons of record given for the hydrino atom.

Given the overwhelming body of evidence for hydrino (lower-energy states of a one-electron atom) cited in the 112 journal articles and 51 independent reports and journal articles, as well as the unprecedented predictability of the Mills GUT as discussed above, including Sections 54-55, 69-70, 112 and 115, the existence of the general case of lower-energy states of one-electron atoms is also established.

Section 118

Examiner Souw again errs in stating on page 4 of the Appendix that:

> On page 111 of the response, applicant asserts that there is no contradiction with respect to the enthalpy of reaction of the catalyst ~ throughout his specification. The Examiner remains unpersuaded because the applicant is now introducing new matter and arbitrary values into his postulated equations (not derived as explained in previous Office Actions) in order to explain his contradictions in his original disclosure.

Applicant has adequately and consistently disclosed the enthalpy of reaction of the catalyst throughout his specification. The two possibilities of m/2X27.2 eV and mX27.2 eV, where in both cases m is an integer, are subsets of each other. This allows for the possibility that: (1) the catalyst increases the central-field interaction by an integer followed by a further release of energy of an integer multiple of 13.6 eV as

derived in Mills GUT and disclosed in the specification; (2) provides for the possibility that multiple species each with an ionization energy of 13.6 eV such as atomic hydrogen or oxygen can serve as the catalyst in aggregate, and (3) the possibly that the catalyst accepts the entire energy of the transition between the initial and final states. An example of a catalyst of case (3) for the transition between the n=1 to the n=1/2 states of atomic hydrogen that was presented in the last Response of 10/22/04 is Ne^+.

For all of the foregoing reasons, Examiner Souw's rejections should be withdrawn and this case allowed.